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J. Morton

Naming

INTRODUCTION

Object naming is superficially a simple task which lends itself to a simple description. Thus, one might imagine that naming an object involves just two stages: firstly, recognizing the object and then finding the name. Questions of the breakdown of object naming in the case of brain-damaged patients would then reduce to questions of the breakdown of one or other of these processes or of a disconnection between them. However, the trend in current cognitive psychology is to try to take as wide a view as possible of any task. Some, at least, of the processes involved in the naming of objects are going to be involved in the use of words in other situations. Study of these other tasks will, then, provide constraints for the model of object recognition.

What I intend to do is to discuss the naming of objects in the context of word recognition. Specifically, I will use my own model for word recognition, the Logogen Model (Morton, 1979; Clarke & Morton, 1983; Warren & Morton, 1982), as the starting point for discussing objects. The format used for the discussion will be that of information processing. In such models, the processes in the brain are seen as modular, or distinct in operation, and are symbolized as boxes, the detailed operation of which is in general not specified in detail. The processes are interlinked by directed lines which are intended to indicate that the result of one process is passed onto another process. The operation of the resulting model could, of course, be described purely verbally, but it is generally found that the complexity of the interconnections is easier to understand in diagrammatic form. It should be noted, however, that there is no necessary implication of anatomical modularity of the processes corresponding to the functional modularity.

THE LOGOGEN MODEL—A BRIEF OUTLINE

The essential features of the revised Logogen model are shown in Figure 9.1. A useful starting point for understanding the model is the assumption that when a word is produced, for whatever reason, one particular process is always involved. This is represented in the model as the output logogen system (also known as the 'phonological lexicon') which consists of a store of phonological codes. When one of these codes is produced it goes to the response buffer which has the function of creating the appropriate motor code to allow the word to be spoken. The assumption (perhaps false) is that this sequence of events takes place whenever the word is spoken, whether the act was triggered by reading the word, hearing it, naming an object or producing the word in spontaneous speech. In

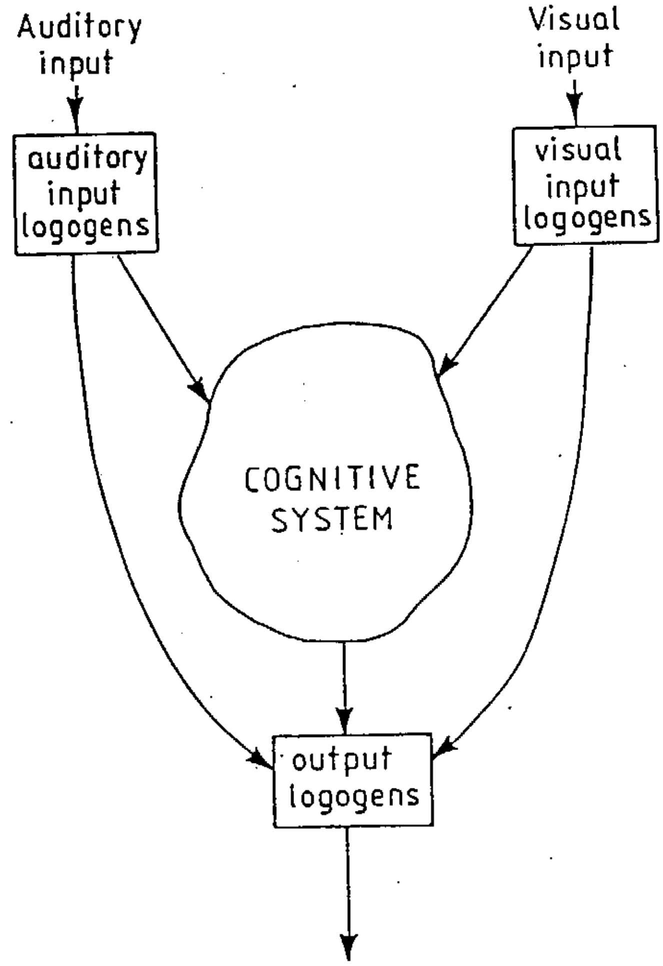

Fig. 9.1 A simplified version of the Logogen model showing the interconnections between various lexical processes.

the case of reading a word there appear to be two possible routes. By the first route, the 'direct' route, there is one-to-one mapping from a visual input logogen system to the output logogens. The second route is the 'semantic' route, whereby after the word has been categorized by the input logogen system, a semantic interpretation is derived from processes in the Cognitive System. This, in turn, can be used to address the output logogen system. With spontaneous speech, the sequence of events would first involve processes in the Cognitive System where information will be assembled to address the output logogens. This model, or variations on it, has been very successful in accounting for a wide variety of verbal phenomena and has proved very productive as a means of describing varieties of acquired dyslexia (Morton, 1981; Morton & Patterson, 1980; Patterson, 1981; Shallice, 1981).

A STRATEGY FOR DISCUSSING NAMING

In the logogen model as described, the naming of objects or drawings will involve at least the output logogen system, since that is the only store of lexical phonology. It is logically possible for there to be a separate source of lexical phonology specific to objects. If this were the case, and given some assumptions about the anatomical separateness of the associated processes and connections, then one would expect to find brain-damaged patients who had problems with object names only when naming (and unassociated with any cognitive or visual defects) and not when reading or in spontaneous speech. One would also expect to find patients who could name perfectly but could not produce the object names in spontaneous speech. To my knowledge, neither of these kinds of patient have been reported. We can thus feel reasonably confident about the use of the same phonological lexicon in all tasks.

For the next series of questions we can ask the extent to which the processes involved in naming resemble those postulated for reading. Specifically, for Figure 9.1, we can ask whether there is a separable process for pictures equivalent to the input logogen system, and if so, whether it is directly connected to the output logogens. An experiment by Warren & Morton (1982) is relevant to the first question. These authors showed that the prior presentation of a drawing led to the facilitation of recognition of a different picture with the same name when presented in a tachistoscope up to 45 minutes later. A sample pair of pictures is shown in Figure 9.2. Both of these were given the name 'clown' by our subjects.

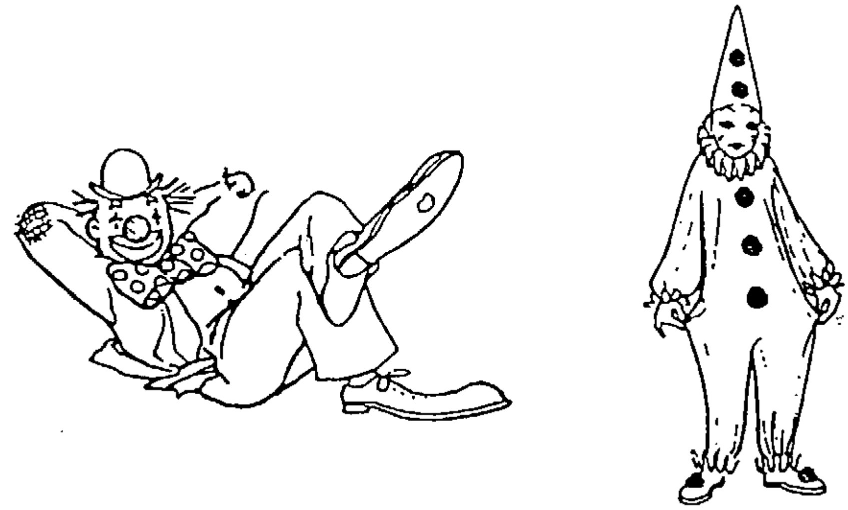

Fig. 9.2 Example of the stimuli used in Warren & Morton (1982). Presentation of one picture led to facilitation in recognition of the other picture 10–40 minutes later.

Although they are visually very dissimilar there was cross-facilitation. This could not have been due to response bias since the prior presentation of the word *clown*, read aloud by the subject, had no subsequent effect upon recognition of the picture under the conditions used. Warren and Morton concluded that there could only be facilitation of the kind shown if there exists a process which is responsible for categorizing pictures. This process, called the Pictogen System, has properties which lead to the facilitation and, since there were no effects from words to pictures, it must be completely independent of the processes responsible for verbal processing. We can represent these relationships quite simply as in Figure 9.3. In this figure the processes necessary prior to the pictogen system have been indicated.

In the experiment described above, Warren and Morton also found that the prior presentation of a picture had a larger effect on the recognition of the same picture than it did on the recognition of a different picture with the same name. This implies that in addition to the pictogen system, there must exist some memory system for pictures in which some kind of literal representation is stored. The existence of such a memory system will become useful in interpreting some results from a brain damaged patient.

In Figure 9.3 it will be seen that there is no direct connection between the pictogen system and the output lexicon. This was one of the issues raised earlier. There are at least two reasons for supposing that no such connection exists. The first piece of evidence comes from an experiment by Durso & Johnson (1979). One of their experiments involved subjects naming a sequence of pictures and words. Items were repeated on occasions and the facilitative effects of this repetition could be compared within and between the types of stimulus. There was facilitation within both pictures and words. There was also strong facilitation from naming a word (i.e. reading it out loud) to the subsequent naming of a picture. Since the time intervals concerned here were of the order of seconds and since the stimuli were presented clearly, there is only a superficial contradiction between this result and the one of Warren and Morton already reported. The critical finding of Durso and Johnson was that although all the other conditions produced facilitation, there was no effect of naming a picture on

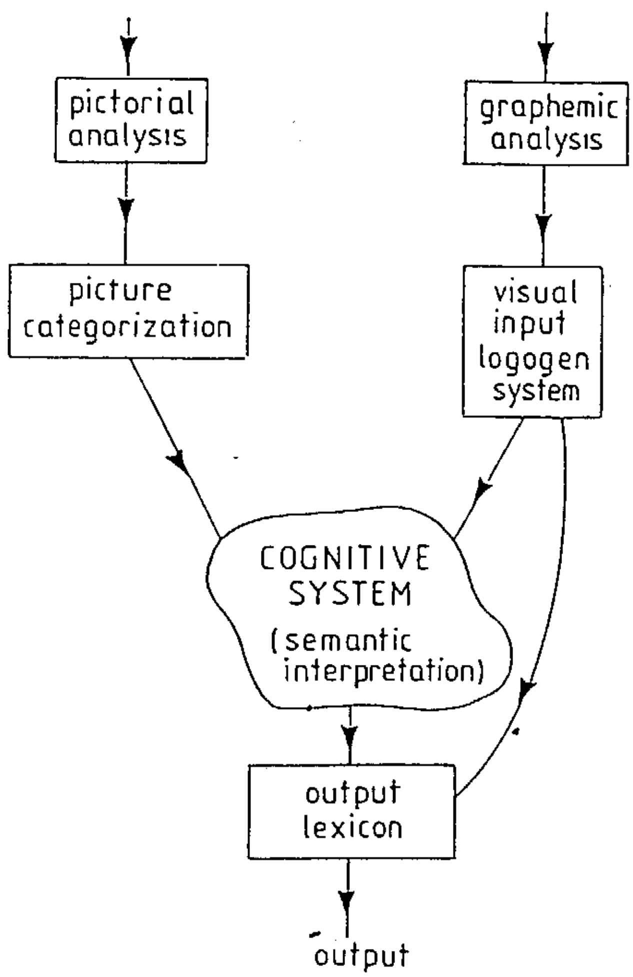

Fig. 9.3 A form of the logogen model which includes picture processing (from Warren & Morton, 1982).

the subsequent reading time for the word corresponding to the picture. Warren and Morton interpreted these results in the following way. For reading a word out loud both the 'direct' route and the route via 'semantics' would be used. Since the direct route is much faster and since naming a picture would not use the processes involved in the direct route (except for the phonological lexicon), we find no effect of pictures on words. Presentation of the words, however, also affects the semantic processes. If we assume that these processes are also involved in picture naming (as indicated in Fig. 9.3) and if we also assume that there is no direct connection from the pictogen system to the output lexicon, then we would expect the effects of words on pictures which were shown by Durso and Johnson. The reason that Warren and Morton found no such effects could be accounted for by the differences in the time intervals and also in the nature of the stimulus presentation. In Durso and Johnson's experiment the stimuli were presented clearly whereas Warren and Morton presented their stimuli in a tachistoscope. In the latter case there is reduced stimulus information and the critical, limiting process becomes the pictogen system. When naming clearly presented pictures as quickly as possible, the limiting process is that one responsible for converting the output from the pictogen system into a form which could be used to find the appropriate phonological form. These correspond to the processes in the cognitive system. This analysis gains further support from another experiment by Durso and Johnson which showed that in a classification task, where pictures and words were judged semantically, there was cross facilitation from words to pictures and from pictures to words. This would be because in both cases the cognitive system would be involved.

It should be noted that Ratcliff & Newcombe (1982) propose a model in which there is a direct connection from pictogens to output logogens. Such a route has some explanatory power in discussing the effects of brain damage, but the data from Durso and Johnson would seem to require that this direct route was slower than the semantic route, to allow for the word-to-picture facilitation.

PICTORIAL ANALYSIS

There is one feature of language that is not shared by pictures. Language has the property that there is a discontinuity between the form of the input and the form of the internal representation. Thus, the partial recognition of a word tells us nothing about what the word might mean. This discontinuity is represented in the model by the logogens, the input to which is a sensory code and the output from which is some categorical code. With objects and pictures we do not find this discontinuity. If we recognize part of an object we can often say a great deal about what the object is. Thus, if all we can apprehend about an object is that it has legs then we know that it is either an animal or a piece of furniture. If we see that it has straight edges then we know that it is man-made and so must be some kind of furniture. Thus while the meaning of a word can only be understood after the word as a whole has been recognized, the meaning of an object, that is its properties, can, at least in part, be determined without having to categorize the object and determine its name.

In the example of a leg, the focus was on a part of the object. J. J. Gibson (1979) has argued at length that many properties of objects as a whole can be determined without having to recognize what the object is. He coins the term 'affordances' to refer to those properties which are 'directly' apprehended. One example of an affordance would be the property of being a container. Within certain size limitations, any object, natural or man-made, which is rigid and hollow can serve as a container. There are, of course, restrictions such as the permeability of the material with respect to the thing to be contained, but this property can be known without having to identify the object. A more complex example, given by Gibson, is that if an object has a surface which is *horizontal*, *flat*, *extended*, *rigid* and *knee-high* then it is *sit-on-able*. Note that one can accept Gibson's analysis of the properties of objects without accepting his idea that such perception is 'direct', that is, that it requires no 'top-down' or inferential computation (see Fodor & Pylyshyn, 1981; Turvey et al, 1981; Ullman, 1980, for further discussion of this point).

The point of this analysis for the present purposes is that it indicates that the nature of the links between peripheral and central processes will be different for objects than for words. Specifically, we have to allow in the model for a connection between some kind of visual analysis and some kind of semantic analysis which bypasses the categorial processes. This idea has been included in the model shown in Figure 9.4. The model has one other property which is an elaboration of the model in Figure 9.3. A separation has been made of two forms of semantics, termed 'object semantics' and 'verbal semantics'. This separation has only the most informal

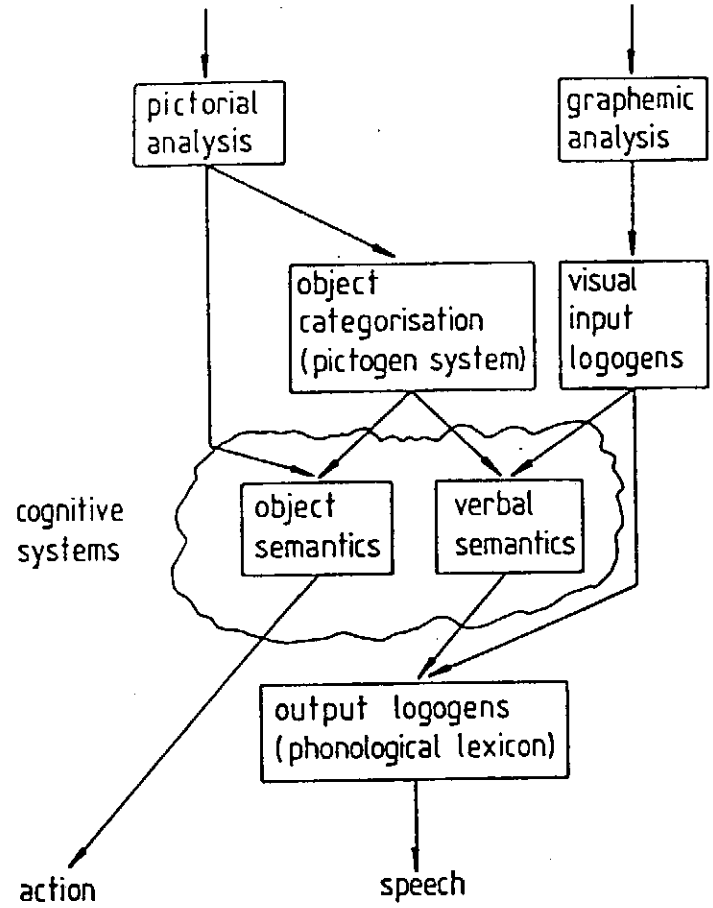

Fig. 9.4 An expanded version of Figure 9.3. This model is incomplete in a number of respects.

justification, and only the sketchiest of definitions. Briefly, the idea is to allow reaction to objects without any involvement of the language systems. Thus, it seems that we can sit on something appropriate or react to an approaching object without verbalization. This subjective impression may be an illusion, and the model does not depend upon the existence of these separate semantic processes. However, the possibility that they exist in separable forms seems no less plausible *a priori* than the assumption that they are one and the same system as in Potter's (1979) Conceptual Coding Theory. Eventually, there will be empirical justification for one or the other view, or even for the existence of a third type of amodal semantics, but for the moment we will assume that there are two separate semantic systems. This assumption is shared by Ratcliff & Newcombe (1982) and by Warrington (1975), among others, though the specifications of the systems differ a little.

The model in Figure 9.4 has some speculative elements. We will see how useful it is in interpreting data from normal subjects and from brain-damaged patients. The processes thought to operate when an object or a picture of an object is presented for naming are as follows. First of all, the image is analysed. The products of this analysis serve two functions. On the one hand, they provide evidence for the pictogen system. This system then provides a categorical output which is sent to the two semantic systems. In the verbal semantic system, this categorial code can be used to find the appropriate semantic description which can then be used to address the output phonology and retrieve the appropriate name. At the same time, two kinds of information will be sent to the object semantic system. One of these will be the categorial code from the pictogen system, and the other will be information sent directly from the pictorial analysis. This will be the form of information already discussed which can be interpreted by the object semantic system without benefit of the categorial information. The object semantic system produces outputs which can be translated into action or can be sent to the verbal semantic system. There are a number of other related processes which I have chosen not to represent in the model in the interests of simplicity. Thus, there must be some ability to use problem solving in order to recognize an object, for example an object viewed from an unusual point of view. Equally, there must be processes which are associated with what is called 'visual imagery'. These will interact with the processes already described but their role in naming is likely to be minimal.

Data from normal subjects

Firstly, it should be clear that we have preserved the properties of the earlier models in the one given in Figure 9.4. Thus, the account of the Warren & Morton (1982) experiment already given will hold here. The facilitation effects between different pictures of the same name is seen as a property of the pictogen system. The facilitation of picture naming after having read the corresponding word is a property of the verbal semantics, as is the cross-facilitation of classification of words and pictures reported by Durso and Johnson (1979). Furthermore, the fact that pictures take longer to name than words take to read is accounted for by the existence of the direct route from input to output logogens, with no corresponding route for pictures. Note that this route is not seen as the application of grapheme-to-phoneme rules, or any other similar mechanism, but is seen as a direct lexicon-to-lexicon link. Thus, we would expect the same data to be found with non-alphabetic scripts. We would also expect Chinese speakers to show the same advantage for characters over pictures, as Potter et al (1979) found.

The next piece of data concerns the relative times for naming and categorizing words and pictures. Potter and Faulconer (1975) showed that while pictures took 260 msecs longer than words to name, in a task which involved semantic classification, performance on the pictures was faster by about 50 msecs. While the model makes no precise predictions about the classification times, the data is clearly consistent with the model, and the possibility of using partial information from the picture to help in the classification task would be one way of accounting for the advantage for pictures.

Data from brain damaged patients

It should be clear that to say of a patient simply that he or she cannot name pictures does not tell us much about the functional deficit that the patient has suffered. One of the tests of the model is that it provides an account of patterns of deficit in an economical way. Let us take first the observation of Rochford (1971), that demented patients make naming errors as do dysphasic patients. Rochford supposed that the errors of the demented patients were due to recognition problems rather than to an inability to find or use the output code. If you remove the recognition problem, then, you should remove the naming problem. He reasoned that being asked to name parts of the body, indicated by touch, should not involve any recognition problem. The results showed that the dysphasic patients had as much trouble naming the parts of the body as they did in naming pictures. The demented patients, on the other hand, were almost without error in naming the parts of the body. In terms of the model in Figure 9.4, we suppose that the dysphasic patients had a problem which involved the output logogens (or access to that system from the verbal semantics), whereas the demented patients had a breakdown of the processes responsible for either object categorization or pictorial analysis. Naming parts of the body would involve processes not shown in the figure which would have an input into one of the semantic systems. The demented patients would then be able to produce an output satisfactorily whereas the dysphasic patients would still have to use the damaged processes.

The study by Rochford, just described, highlights the fact that simply knowing that a patient cannot name an object does not tell us a great deal about that patient. What I will now do is describe briefly the general classes of disorders of naming. In this I will draw extensively from Ratcliff & Newcombe (1982). These classes of disorder will be interpreted by reference to the model in Figure 9.4.

Nominal dysphasia

This is by far the most common reason for failure to name an object. Most aphasic patients have an object naming deficit which is independent of the modality in which the stimulus is presented (Goodglass et al, 1968) and unaffected by the degradation of the stimulus, whether objects, photographs or line drawings are used, or whether the object is drawn in a plausible or implausible context (Corlew & Nation, 1975; Hatfield et al, 1977). The errors which these patients make, apart from omissions and perseverations, typically bear a semantic or phonological relationship to the correct response. Naming is nearly always facilitated if the sound of the initial one or two phonemes is provided by the experimenter. These patients can usually mime the use of the object presented or, however haltingly, describe its use. These factors indicate that the objects have been recognized and that the main problem is one of 'word finding'. In terms of the model in Figure 9.4, we would say that such patients have a problem getting from the cognitive systems to the output logogen system. There is also the likelihood that many of them have purely semantic problems (Zurif et al, 1974; Whitehouse et al, 1978) but all the processes concerned with object recognition are intact.

Optic aphasia

The defining characteristic of optic aphasia is of a modality-specific breakdown in naming. The patients cannot name pictures of visually presented objects, but have no problem in naming tactually presented objects. It is usually claimed that these patients recognize the objects they cannot name. The evidence for this is that the patients can indicate the use of the objects and can point to named objects. In naming, the errors tend to be semantically related words, resembling those errors sometimes made by dysphasic patients. However, the accurate naming to tactile presentation precludes an account of optic aphasia based on output malfunction.

One patient was able to draw from memory an accurate representation of a picture he had been unable to name correctly (Lhermitte & Beauvois, 1973). This patient was typical in that he presented no problems which could be ascribed to basic visual processes.

The simplest account of this patient is that the pictogen system was not operating. This would preclude accurate recognition. Thus, the tests of recognition become crucial. Miming the use of an object is not the most precise way of establishing that the object has been completely categorized, and tests involving pointing to named objects depend crucially on the alternatives presented. Furthermore, the ability of the patient to reproduce a drawing from memory is not germane, since it has already been pointed out that to account for the Warren & Morton (1982) data, it is necessary to postulate a visual memory system independent of the pictogen system (this system was omitted from Figure 9.4 in the interests of simplicity). In the absence of firm data concerning recognition, the loss of the pictogen system alone would give rise to the pattern of symptoms, partial recognition, sufficient for miming the use, being achieved via the direct route from visual analysis to the object semantic system.

If it turns out that there are optic aphasics in whom recognition of objects is complete and instantaneous, then the above account will not serve and some account involving the semantic systems would have to be used (c.f. Beauvois, 1982).

Visual agnosia

By definition, agnosic patients do not recognize objects or drawings. Thus, there either has to be no input into the semantic systems from the object processing, or the semantic systems themselves must be damaged. There are two main classes of agnosia. In the first, Apperceptive Visual Agnosia, patients are unable to copy or match drawings they cannot recognize. There is also breakdown in other tasks involving pattern or shape perception (Rubens, 1979). These patients are most simply described as having problems with the visual analysis system.

The more interesting group of patients are those termed Associative Visual Agnosics. In one sub-group, only the visual modality is affected, and in another, both visual and tactile recognition are affected. In both types, the patients can make recognizable copies of drawings they cannot recognize and can successfully perform matching tasks (Rubens & Benson, 1971; Taylor & Warrington, 1971; Warrington, 1975). In the case of Warrington's patients, the matching extended to photographs of objects taken from widely differing views. Such performance indicates that the pictogen system was operating perfectly. The photographs were correctly categorized, but the result of the categorization process could not be used by the semantic systems, either because of damage to the latter, which is the explanation preferred by Warrington, or because of some disconnection. In the case of Warrington's patients the former account seems likely since her patients also showed semantic deficits to verbal stimuli, as did a patient of Ratcliff & Newcombe (1982).

It should be noted that individual patients within the classical taxonomic groups often differ widely from one another in performance on tasks not central to the syndrome. This means that we are unlikely to find a uniform account of all patients in a group.

The above account of the kinds of patient exhibiting naming problems is extremely sketchy. It should serve, however, to illustrate how different functional deficits can lead to the same superficial problem. The model in Figure 9.4 is much too simple (c.f. Seymour, 1979). Only when it is elaborated and detailed studies are made of individual patients on a variety of tasks designed specifically to test hypotheses within the model, are we going to get a satisfactory linkage between cognitive psychology and neuropsychology with respect to object naming.

REFERENCES

Beavois M F Optic aphasia: a process of interaction between vision and language. Philosophical Transactions of the Royal Society of London B298: 35–47

Clarke R G B, Morton J 1983 The effects of priming in visual word recognition. Quarterly Journal of Experimental Psychology 35A: 79–96

Corlew M M, Nation J E 1975 Characteristics of visual stimuli and naming performance in aphasic adults. Cortex 11: 186–191

Durso F T, Johnson M K 1979 Facilitation in naming and categorizing repeated pictures and words. J. Exp. Psychol, Human Learning and Memory 5: 449–459

Fodor J A, Pylyshyn Z 1981 How direct is visual perception? Some reflections on Gibson's 'Ecological Approach'. Cognition 9: 139–196

Gibson J J 1979 The ecological approach to visual perception. Houghton Mifflin, Boston

Goodglass H, Barton M, Kaplan E 1968 Sensory modality and object naming in aphasia. Journal of Speech and Hearing Research 11: 488–496

Hatfield F M, Howard D, Barber J, Jones C, Morton J 1977 Object naming in aphasics—the lack of effect of context or realism. Neuropsychologia 15: 717–727

Lhermitte F, Beauvois M F 1973 A visual-speech disconnexion syndrome. Brain 96: 695–714

Morton J 1979 Facilitation in word recognition: experiments causing change in the Logogen model. In: Kolers P A, Wrolstad M E, Bauma H (eds) Proceeding of visible language. Plenum Publishing Company, New York

Morton J 1981 The status of information processing models of language. Philosophical Transactions of the Royal Society of London B295: 387–396
Morton J, Patterson K 1980 A new attempt at an interpetation. In: Coltheart M, Patterson K, Marshall J C (eds) Deep dyslexia. Routledge and Kegan Paul, London
Patterson K E 1981 Neuropsychological approaches to the study of reading. British Journal of Psychology 72: 151–174
Potter M C 1979 Mundane symbolism: the reactions among objects, names and ideas. In: Smith N, Franklin M B (eds) Symbolic functioning in childhood. Erlbaum, Hillsdale NJ
Potter M C, Faulconer B A 1975 Time to understand pictures and words. Nature 253, 5491: 437–438
Potter M C, So K-F, Ng K-F, Friedman R 1979 Reading in Chinese and English (article in preparation, referred to in Potter)
Ratcliff G, Newcombe F 1982 Object recognition: some deductions from the clinical evidence. In: Ellis, A W (ed) Normality and Pathology in Cognitive Functions. Academic Press, London
Rochford G 1971 A study of naming errors in dysphasic and in demented patients. Neuropsychologia 9: 437–443
Rubens A B 1979 Agnosia. In: Heilman K M, Valenstein E (eds) Clinical neuropsychology. Oxford University Press, New York
Rubens A B, Benson D F 1971 Associative visual agnosia. Archives of Neurology 24: 305–316.
Seymour P H K 1979 Human visual cognition. Collier Macmillan, London
Shallice T 1981 Neurological impairment of cognitive processes. British Medical Bulletin 37: 187–192
Taylor A, Warrington E K 1971 Visual agnosia: a single case report. Cortex 7: 152–161
Turvey M T, Shaw R E, Reed E S, Mace W M 1981 Ecological laws of perceiving and acting: in reply to Fodor and Pylyshyn (1981). Cognition 9: 237–304
Ullman S 1980 Against direct perception. The Behavioral and Brain Sciences 3: 373–416
Warren C, Morton J 1982 The effects of priming on picture recognition. British Journal of Psychology 73: 117–129
Warrington E K 1975 The selective impairment of semantic memory. Quarterly Journal of Experimental Psychology 27: 635–658
Whitehouse P, Caramazza A, Zurif E 1978 Naming in aphasia: Interacting effects of form and function. Brain and Language 6: 63–74
Zurif E, Caramazza A, Meyerson R, Galvin 1974 Semantic feature representations for normal and aphasic language. Brain and Language 1: 167–187