Functional Explanation in Context*

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The claim that a functional kind is multiply realized is typically motivated by appeal to intuitive examples. We are seldom told explicitly what the relevant structures are, and people have often preferred to rely on general intuitions in these cases. This article deals with the problem by explaining how to understand the proper relation between structural kinds and the functions they realize. I will suggest that the structural kinds that realize a function can be properly identified by attending to the context of functional explanation.

1. Introduction. We are commonly told that the special sciences refer to properties that have multiple realizations. There are theories in such sciences that make reference to functional properties, which can be realized by different kinds of structures on different occasions. This point has been made for sciences as diverse as physiology and psychology. As Ned Block has recently observed, "there has been a consensus . . . that reductionism is a mistake and that there are autonomous special sciences: this consensus has been based on an argument from multiple realizability" (1997, 107). But the importance of this point is matched by the unclarity in the arguments presented for its occurrence. The arguments for multiple realization have, recently, been getting the attention they deserve, and it has become apparent that there are problems with the traditional arguments offered (Kim 1992; Bechtel and Mundale 1999; Shapiro 2000; Bickle 2003; Couch 2004; Polger 2004). One problem at issue is how we should identify the structural kinds that realize the functions in the examples that are offered. This article will suggest there are constraints that exist for identifying the structural kinds that depend on the context of functional explanation that can help with this problem.

Here is how I will proceed. In Section 2, I will present a recent example

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of multiple realization and describe what the problem is with this kind of example. In Section 3, I will provide an account of how the structural kinds in the example can be identified in the context of functional explanation. My suggestion will be that a proper understanding of functional explanation helps us to narrow down the structural kinds that we should appeal to in giving the explanation. In Sections 4 and 5, I will explain how the account provides us with a notion of relevance that improves over other accounts that have been offered. Finally, in Section 6, I will explain how the account enables us to better evaluate claims about multiple realization and deal with the problem with the initial example that we considered. I should make it clear that my concern here is not to deal with all the difficulties that exist with the examples of multiple realization that have been presented, since the different examples require separate treatment. The concern I have is, rather, with providing a more precise way of thinking about the relation between structures and the functional properties they have. Clarity about this issue is needed before we can properly evaluate the examples that have been presented.

2. An Initial Example. It will be useful to have a concrete example of multiple realization that we can work with in this article. Let us consider a recent example that involves the function of light reception in the human eye.[1] The function concerns the ability of a structure to receive and respond to light. This consists in the ability to detect light in the environment, and to initiate an electrochemical response (Wulff 1992). Let us suppose that we have two human eyes that differ from one another in some way (in different individuals). We know, for example, that there are individuals with three kinds of visual pigments in the cones in the retina, who are trichromatic. There are other individuals with two kinds of visual pigments in the cones, who are dichromatic. It would seem that this provides an example of different realizers of the kind light receptor in a way that is not merely trivial on its face. The structures differ in terms of the kinds of visual pigments that are present in the receptors, which are the basic molecular structures in the eye involved in the interaction with light. The pigments are called rhodopsins and are made from a protein joined with a form of vitamin A, and the differences in the eyes concern the differences in the protein constituents in the molecules (Wolken 1995). Due to the differences that are present, one of the eyes will be capable of discriminating the normal colors of objects in the environment, while the other eye will be color-blind in some respect.

There are various things that one might want to say about this sort of

1. For other philosophers who have discussed the example of eyes in a similar context, see Block 1997 and Shapiro 2000.

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example. One thing to note is that the structures can be classified as belonging to different kinds at different levels of description. Consider the different ways the eyes can be described in terms of their structures. At one level of description, we can refer to the differences in the visual pigments of the structures. If we use this difference as the basis for our classification, then the structures will be classified as belonging to different kinds. But at a different level of description the eyes are not different from one another in the components they contain. If we describe the visual pigments in more general terms, then there will be no basis for distinguishing between the structures. For example, we know that the visual pigments in the receptors are all composed of similar forms of rhodopsin molecules. The differences that exist between the structures, as a matter of fact, only relate to differences in the *particular kinds* of rhodopsins present in the receptors.

Now, suppose in this situation that we are presented with the following suggestion. Imagine a person focusing their attention on the kind "light receptor." The individual human eyes were said to be different kinds of structures that belong to the kind. The person might take this to be clear evidence that the same kind of function is realized by different kinds of structures. However, the problem with this is that it overlooks what was noted about the example. While there are some structures that differ between the eyes, we have seen that they share a common structure at another level of description. So the idea that they belong to different structural kinds overlooks the property that the structures have in common. Whether we are presented with a genuine example of multiple realization in this case seems to depend on the level of description we choose to use, and it is not clear at this point which level of description is appropriate. The problem the example raises occurs with many examples that have been offered in the literature (although I do not want to suggest all). The claim that functional kinds are multiply realized is typically motivated by examples of things like computers and their hardware, or psychological and brain states. But, as Bechtel and Mundale have observed about the latter example, the proponents of multiple realization "have typically failed to provide us with a context in which to ask whether two occurrences involve the same or different psychological or brain states" (1999, 178). What we need is some assurance that the structural kinds mentioned in the examples are relevant for establishing the point at issue, since, without this, there is no reason to believe that the examples present us with a problem.

3. Constraints on Functional Explanation. To deal with this situation, we need a more precise account of the relation between structures and functions than has been offered. I think this can be provided by considering

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the notion of functional explanation in the manner suggested by Robert Cummins ([1975] 1998). This is relevant because when we explain how a structure realizes a function we have to determine which components of the structure are required for the explanation. To give the account, I want to leave the notion of multiple realization aside for the time being, and focus only on how to identify the structural kinds in the example of an individual structure. I will consider what we should say about the example first, and then explain how the idea applies more generally.

Let us consider one of the human eyes from before. The issue is how we can determine which components of the structure are appropriate to appeal to in explaining the presence of a function. The first thing we should accept is that there may be components of the structure that are relevant to the function, and certain components that are not. We can put this by saying that the components of a structure are relevant (non-trivial, whatever) to some function only if they are needed in some way for the presence of the function. Some notion like this, I take it, lies behind the intuitive thought that certain components are, and others are not, relevant to a given function present (we will make this more precise in a moment).

We can see how this works in terms of the individual eye. Say that the function we want to explain is the capacity of the human structure *S* for "light reception" *F*. We know that not all of the components of *S* are relevant to *F*. Rather, there will only be some (proper) subset of the components that are relevant and that serves as the realizer. Now, there are numerous components in a structure like the human eye that may be relevant to the function. The structure contains components including (1) an iris, (2) lens, (3) receptors, (4) visual pigments, (5) outer shell, (6) choroid, and so forth. The components are each important features of the eye, and part of its overall structural makeup. An examination of the eye would likely identify these as major features that are related to the operation of the structure.

In the present case, though, there is no reason to appeal to all of the components that were mentioned in the explanation of *F*. We know that the human eye works by responding to incident light. When incident light reaches the retina at the back of the eye, what happens is that the visual pigments in the receptors are activated. The light on the visual pigments causes them to undergo a conformational change that initiates an electrochemical response in the receptors in the retina, and which leads to the nervous signal. So we can say it is the receptors (3) and the visual pigments (4) that are responsible for the capacity of the eye to respond to light in the manner indicated, and that serves as the realizer. Note that this is also how vision researchers describe the situation. As the researcher Jerome Wolken states, "the basis [*sic*] for photosensitivity in living or-

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ganisms is in their photoreceptor pigment molecules . . . that are chemically structured to absorb . . . energies of light" (1995, 4).[2] Researchers accept that it is the visual pigments in the receptors that are at work in these circumstances. This is not to deny that the other components may be relevant to certain aspects of the functioning of the eye; but in giving the explanation we should see that the other components can be ignored. The other components should be conceived as providing the background conditions in which the components in question operate. In this sense what is needed is for us to distinguish between the components that indirectly support, and those that serve to realize, the function that is being explained.

We can make this clearer by considering as an example of an irrelevant component the iris (1). The iris is part of the optical system, as we know, that serves to focus light onto the retina (by controlling the opening of the eye). It is also a conspicuous component of the structure that is involved in the eye's overall makeup. Since the iris is important in enabling the eye to perform certain functions, it might be thought to be part of the realizer for *F*. However, the iris is not involved directly in the detection and response to light; the role of the iris is, merely, to regulate the amount of light that reaches the retina. A similar point is noted by physiologists Walter Bock and Gerd von Wahlert in their discussion of character complexes in physiology. As they write, "features which are integral components of a complex can be eliminated without affecting the basic operation of the whole unit. The iris of the vertebrate eye does not influence the basic mechanism of sight: it only permits the animal to adjust to different light intensities" ([1965] 1998, 122). This is why the component does not need to be mentioned in giving the explanation of *F*. The fact that the iris plays a role in the eye does not mean that it is relevant to the particular function that is being explained.

We have considered how the components within the structure are relevant to the function at issue. Consider, next, another function of the eye related to the function *F*. Suppose, for instance, that our interest is in explaining the eye's ability to function as an "image-forming light receptor" *F**. This is a *more specific* function of the eye that consists in the ability to form images of the environment. We know that the function can be performed by the human eye because it possesses the appropriate kind of optical system (this matters, because not all kinds of eyes are image-forming systems; see Wolken 1995). In this case I would suggest that we would need to appeal to the additional components of the eye to explain the presence of the function. So, for instance, the iris (1) is needed

2. A similar characterization is also provided by Wulff (1992, 446).

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for regulating the amount of light that enters the eye, which is important to avoid blurring of the image. The lens (2) is needed for focusing the light on the retina, which is needed to form the image itself. The receptors (3) are needed for neural signaling within the retina; and so forth (for whatever components are needed). The additional components are involved in enabling the structure to form images of the environment. Because the components of the structure are needed to explain the behaviors associated with image formation, they have to be included in the description of the realizer that is involved.

These considerations suggest a view of the relation between a structure like the eye and its functions that we need to make explicit; we can describe the view in general terms. A structure like the human eye belongs to different kinds at different levels of description. The eye belongs to different structural kinds depending on the components of the structure that are characterized in the description (the receptor system, the receptor + optical system, etc.). We can describe the structural kinds at more specific levels of detail as we need depending on the explanatory concerns that we have. Furthermore, there is a similar point that applies to the *functional* kinds used in characterizing the behavior of the structures as well. At one level of description there is the capacity for light reception, at another the capacity for image-forming light reception, at another color image-forming light reception, and so forth. There is a series of kinds the structures belong to that are capable of being described at more specific levels of detail.

We have seen that a structure like the eye consists of numerous components. Depending on the function, we have to appeal to different components within the structure. The particular components we have to include in describing the structure are the ones needed to explain the behaviors that are distinctive to the function at issue; this is the account that we have been developing. To make this view more precise, we can put the account in the following terms. Let us say that a set of components P realizes function F on the occasion of being present in structure S if and only if P are the components we need to invoke in explaining how it is that S performs function F (this point can also be expressed in terms of properties if preferred). This provides the right way of explaining what makes something a realizer of a particular functional property.

The points we have described are important for making sure that we have identified the appropriate structural kinds in considering the examples presented. This fact is often overlooked in discussions about what is involved in explaining a functional property, but it needs to be considered. There is evidence, in fact, that Cummins himself recognized there is a need to distinguish between the relevant and irrelevant components of the structures involved in giving the explanations. He mentions at one

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point, for example, that "what makes something part of, e.g., the nervous system is that its capacities figure in an analysis of the capacity to respond to external stimuli, coordinate movement, etc." ([1975] 1998, 196, note 25). The idea seems to be that something counts as a component of a system only if it is involved in the explanation of the presence of the function. I believe that we need to be mindful of this point if we want to be clear about how to identify the kinds in the various examples that have been offered.

There are two points it will be useful to make about the account presented at this point to be clear. First, we have seen that while there are several components that are part of the human eye, only certain of these will be needed for the function. The talk of "needed" here is important since we are interested in explaining what has to occur for the presence of the function. The idea is that we explain why a structure possesses a function in terms of the structural components (and their organization) that serve as the realizer. The realization relation at issue is understood to be a kind of noncausal determination relation that exists between a structure and a function.

There are different ways that people have tried to understand a structure being a realizer for some function. One common suggestion in the early literature (e.g., Endicott 1989) was that we should think of the realizer as whatever structure it is that is physically sufficient for the function;[3] but this suggestion is problematic if it is stated this simply. To see this, suppose that we have a structure that contains components *ABC* and that is sufficient to bring about the function *F*. If this structure is sufficient for *F*, then so will be the structure that consists of components *ABCD* (where *D* is an extra component that does not counteract the others). These kinds of mere components of the structure like *D* do not serve to bring about the function and should not be included in the description of the realizer involved. The components whose removal do not affect the function do not have a determinative role to play in the presence of the function, and do not need to be mentioned in the explanation that is being given.

The account I have given accepts that the components of the structure involved will be physically sufficient for the presence of the function. This is in keeping with the common view that a structure realizes a function relative to the physical laws that hold in a world. But we need to add further conditions to the account to deal with the problem we just described. What needs to be added is the idea that the components that

3. Note that the notion of physical sufficiency that is used is meant to go beyond a mere causal connection in these discussions. The notion involved is usually taken to be strong enough to imply supervenience or realization.

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make up the realizer are the ones that are needed for the presence of the function. This idea can be included in the account by saying that the components of the structure will be necessary-in-the-circumstances for the presence of the function; they are the components that have to be present. We can put these ideas together by saying that a structure will realize a function under the following conditions: the structure consists of components that are individually physically necessary and jointly sufficient-in-the-circumstances for the presence of the function.[4] By putting the relation this way we are able to be clear about what it means for the components of a structure to be involved in realizing a functional property.

This provides us with a means of identifying the components of the structure that are involved in realizing the function as well. We can think of the components in a way similar to the notion of an *inus* condition characterized by J. L. Mackie (1965). The components that matter are the ones that are an insufficient but necessary part of a complex structure that serves as the realizer for some function. If we consider the above example, for instance, this means that each of the components of the complex structure *ABC* will be a necessary part of the structure that realizes the function. This is not to suggest that the account Mackie offered used the same notion as the one we described, of course; the notion he described was not concerned with the nature of the realization relation, but with causal relations. Despite this difference, I think that something similar to the account he offers can be used to help us understand what makes a component of a system relevant to a particular effect.

Second, it is important to be clear about what the account is claiming and what it is not. The account I have presented does not make a general claim about the structural kinds that may serve to realize a functional kind. The claim is that there will be a set of components that are individually necessary and jointly sufficient for a given structure present. This, we should note, is compatible with the physical possibility of there being more than one kind of structure that realizes the same kind of function. We can accept, for example, that the structure in some eye is sufficient to realize the functional kind *F*, and that a distinct structural kind in some other eye is sufficient to realize the kind *F*. In that case neither of the kinds of structures would be necessary in a general sense. We can accept that whether this happens is an a posteriori question that depends

4. We might worry about the strength of the modality here for various purposes. My concern in this article is to correct what I consider to be the "loose descriptions" of the structural kinds that are often offered in giving examples of multiple realization. Since I think that this can be done without adopting an account that is any stronger than the one presented, we can leave these issues aside. For discussion of some of the issues involved here, see Kim 1984.

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on the details of the structures at issue. Leaving this issue aside, we should recognize that this does not prevent the components in a structure from being necessary in the particular case. The present discussion, as we said before, is not concerned with the possibility of multiple realization, but with getting clear about how the structures involved are related to the functions that they have. We should be concerned with this issue in relation to the individual structures before asking about differences across the structures described.

4. Block's Account. Before continuing it may be worth asking how this account is different from other accounts that have been presented on this subject. In some discussions of the subject, we are never explicitly told how we should distinguish the relevant and irrelevant components of a structure. Consider an account mentioned by Block in his discussion of how to identify the appropriate structural kinds in the examples offered. Block notes that proponents of multiple realization sometimes focus on differences that are present between some structures, and that not merely any properties of the structures are appropriate to consider ([1978] 1980, 270). He claims, for example, that two structures made of wood and metal can have different microphysical compositions even though they possess the same property of temperature. And he says that in this situation the differences in their compositions are not important to whether they possess some common physical property (e.g., mean kinetic energy) that serves as the realizer of the property of temperature. In making this point, Block mentions that the properties of a structure that are important to issues about realization are its "nontrivial properties." But unfortunately he does not explain what it means for something to be a nontrivial property. The problem with this is that it is ambiguous between the different senses of relevance we have distinguished. Consider how this applies to the example of the visual systems we are considering. Presumably, nobody is going to think that a difference of two or three receptors in the retina of a human eye is sufficient to distinguish the eye in kind from an otherwise identical structure (there are thousands of receptors); this difference is not enough to make a difference and is irrelevant. But consider the previous example of the iris which is more difficult. We have seen that the iris is a "nontrivial" feature of the operation of the eye in virtue of being one of its main components. But whether the iris is one of the main components of the structure is not related to whether it is needed to explain the presence of a function that is in question.

The problem with the suggestion is that it does not provide us with a clear account of the notion of relevance. The relevant components of a structure are not the ones that are broadly involved in the operation of the structure. The relevant ones are those that are involved in the par-

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ticular function that is being performed, where this consists in those components that have to be present for the function to occur on an occasion. The virtue of the account we presented is that it provides us with a precise way of explaining what the notion of relevance amounts to. Keeping this point in mind is important if we want an understanding of how to identify the structural kinds in the examples.

5. Shapiro's and Kim's Accounts. Another account that has been presented is Lawrence Shapiro's (2000) in his discussion of the subject. He discusses the notion of relevance in relation to the problems we are considering. He says that the properties of a structure that make for different realizations are only certain properties of the structure. Discussing two corkscrews that are entirely alike except for the differences in their color, he remarks that these "are not different realizations of a corkscrew because differences in color make no difference to their performance as a corkscrew" (2000, 644). What matters to the structures being realizers of a function is only the causally relevant properties that contribute to the function in question. On the account he provides, we have different realizers where we have structures that consist of different causally relevant properties. But once this is recognized, he notes, this implies there are not genuine cases of multiple realization since causally distinct properties do not belong to the same kinds. He writes that "if the realizing kinds do genuinely differ in their causally relevant properties, then, it seems, they are different kinds. But if they are different kinds . . . we do not have a case in which a single kind has multiple realizations" (2000, 647). The idea seems to be that, where the causally relevant properties of the structures are different, we will have different functional kinds, and so these will not be instances in which we have genuine multiple realization. Note that this account depends on individuating the structural kinds that make up the realizers in terms of their causal powers. This is important since this is what motivates the idea that the functional kinds that are present are different as well.

A similar account along these lines has been developed also by Jaegwon Kim (1992). He suggests that the problem with the standard arguments for multiple realization involves two basic points. He first notes that, according to the standard account of these issues, kinds are perceived as being individuated causally. Two structures (or events) will fall under the same kind just when they possess the same causal powers as each other. This is because kinds are counted as distinct when the structures involved enter into different causal relations (this is the same conception we just considered). Kim then adds to this a claim about how we should understand the relation between structures and functional properties. He claims that, when a particular structure realizes a function on an occasion, the

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causal powers of the function will be identical to (or a subset of) the causal powers of the structure that realizes it. The causal powers of the two must be the same, since there can be no causal powers contributed by the function in addition to the causal powers contributed by the structure. In this way, Kim says, we can see the causal powers of the function as being inherited from the causal powers of the structure that serves as the realizer. He claims that this is the right way to understand the relation between structures and functional properties.

The problem for Kim is that this implies that the same kind of function cannot be realized by different kinds of structures. According to the example presented, the structural kinds that realize the functions are diverse. But if the structural kinds involved are diverse, then the functional kinds will be diverse as well. The implication of this is that there is no reason to think multiple realization is plausible with this way of thinking about the issue since there are no conditions in which it can occur.

There are various problems one might have with both of the accounts we described. My interest here is not to address all of the concerns that might be raised with the accounts, but to note some difficulties they have and contrast them with the account we presented. The first problem to note with the accounts is that they provide us with a way of understanding the notion of relevance that depends on the causal theory of properties we don't need to commit ourselves to. The problem we have been considering concerns the loose descriptions offered of the structures in the various examples given. It seems to me that there is room for a view that enables us to deal with the problem of loose descriptions in the examples, but which doesn't turn on accepting a controversial theory of properties such as this. This is not the place to go into the details of the theory of properties, which is beyond our present concern (see Heil 2003 for difficulties with the causal theory of properties). But let me note that this way of approaching the issue turns it into a difficult problem in metaphysics about our understanding of the nature of causal powers whose resolution is unclear. Instead of approaching the issue in these terms, I have presented a different way of dealing with the problem. The alternative presented appeals to the notion of explanation in narrowing down the structural kinds that serve as the appropriate realizers. The idea is that we explain the notion of relevance in terms of the components of the structures that have to be appealed to in explaining the presence of the functions. So there seems to be no need to adopt these approaches if our concern is with identifying the structural kinds that are relevant to the examples considered.[5]

5. I should note that, in more recent work, Shapiro (2004) provides a different account of the relation between structures and functions that is closer to the account being

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A second problem we can note is that the accounts make it difficult to understand why anybody would have thought there were good examples of multiple realization to begin with. When originally introduced there were several examples of multiple realization offered as having support from the sciences. But if these approaches are right, then we are wrong in thinking that there are genuine examples of multiple realization given our understanding of how to individuate kinds. There are conceptual arguments available to show that the examples that have been offered are implausible.

The account I have presented attempts to avoid this approach, and accept that there are genuine empirical issues involved in deciding whether or not we have an example of multiple realization. With the account we approach the problem by trying to be more precise about the conditions under which we have examples that are worth considering. This is consistent with the kinds of empirical arguments that were originally offered to show that multiple realization occurs (though there were other arguments also). The hope is that this will, in turn, enable us to focus more squarely on appropriate examples, and move beyond the often overly simplified examples that can be seen to dot the literature. There are different areas of inquiry that may provide different reasons for why multiple realization occurs, and we should not simplify the problem by suggesting that there is a single answer for all cases. If our aim is to understand how the various sciences work, then we should be open to finding different results in different places.[6]

6. The Account in Practice. I have presented to this point an account of

defended here which was developed separately. But I am unclear whether his account depends on a similar appeal to the causal theory of properties. Furthermore, the account he provides does not develop the notion of relevance by appeal to the notion of necessity and the *inus* notion that we described. These features are important as they enable us to be precise about how to describe the appropriate relations.

6. Another account that is worth mentioning in this context defines functional properties as higher-order properties. A functional property is said to be the property of having some property that plays role R. In this case, we can say that if F is the property of having some property P that plays role R, then whenever some structure has F and has some P that plays role R, then P is the realizer of F on that occasion. But this account is helpful only if we are clear about what it means for a property to "play" a functional role. The concern is that this notion may be ambiguous in the way that the earlier notion of being a realizer was ambiguous. We saw that the structures ABC and $ABCD$ may both be said to "play" the same functional role since whenever each is present the function will be present. But not all of the properties mentioned in these structures are relevant to the function. So it seems that this account takes us back to the issue raised in Section 3 about how we should distinguish the relevant and irrelevant properties of the structures. For related concerns about how to understand the notion of playing a role, see Kim 1998, 129, note 45.

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functional explanation that is sensitive to how the structures involved should be individuated. My concern has been to make the conditions under which a structure realizes a function more precise. I have been careful, though, not to suggest that the account serves to rule out the same kind of function being realized by different kinds of structures. I have accepted that, for the arguments we are considering, whether this occurs is a matter for empirical investigation. But we have yet to consider how to deal with the suggestion of multiple realization itself, and we should look at the example we have been discussing to show how the view works. This will be helpful because there is often disagreement about how to evaluate specific examples properly.

We can consider the differences that we know to be present between individual eyes with the example we described before. The kinds of differences at issue concern differences in members of the same species, notice. For some it may seem that there are not great differences among the structures of individuals of the same species; but, in fact, these cases have been said by many to be crucial for understanding just how widespread the problem of multiple realization is (Block and Fodor [1972] 1980; Horgan 1993). Horgan has claimed, for example, that the differences present among individuals are necessary to appreciate because they show that even the strategy of restricting reductions to particular species is implausible (the problem occurs "even in humans" [1993, 308]). There are, of course, other examples presented that concern differences across species that are in certain respects more complicated than the ones we are examining. But these kinds of cases raise considerations that go beyond the present discussion and depend on issues that need separate examination. Instead of considering these, I will try to illustrate how the account applies to the particular case that concerns us.

Let us focus on the example of the trichromats and dichromats that we considered before and didn't give an answer to. We said that there are differences in the visual pigments that are present in the receptors of the structures. The fact that there may be differences of some kind between the structures does not of itself show that the differences have to be considered as distinguishing the structures. But, in this case, we know that the differences present refer to components that are uncontroversially involved in the functions of the eyes in some way, since nobody would deny that the pigments play a role in the eyes' capacities to initiate a signal in response to incident light. The question is whether this provides us with an example where the function of light reception is multiply realized in relation to the account.

This kind of suggestion is problematic as an example. The example is correct in identifying the differences among the structures of the eyes since we can hardly deny that the differences mentioned exist. But the fact that

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the structures may exhibit such differences does not show that the differences mentioned are related to the structural kinds involved in the performance of the function. The problem is with the description of the structures as containing different kinds of visual pigments as these are not what are important for the capacities of the eyes to respond to light. What enables the eyes to respond to light is the presence of a molecular mechanism that undergoes a transformation in response to incident light; but this is a structure in common to the different individuals in this case. There is support for this point as well when we consider researchers' way of describing the relevant mechanisms. As one researcher notes, the "light-sensitive pigments of vertebrate and invertebrate photoreceptors which have been investigated appear to have a similar chemical constitution. Rhodopsin . . . consists of a protein [opsin] conjugated with a carotenoid [retinal]" (Wulff 1992, 449). As long as this basic molecular structure is present in the receptors of the individuals, then the eyes will be able to respond to light in the environment. If this is correct then what we should say is that the structures are capable of responding to light because they each contain rhodopsin molecules. We can explain how the function is performed in terms of there being a similar structural kind at the relevant level of description.

Notice that this is not to suggest that there are no contexts in which the differences in the structures might be important. The differences in the visual pigments surely have some role to play in the structures of the eyes. We can accept this point without believing that this is sufficient to show that the structures differ in the relevant way. For the differences in the visual pigments are responsible for differences in the eyes' capacities to respond to light. For example, we know that the cones in the receptors of the normal system have peak sensitivity in three regions of the electromagnetic spectrum—approximately 430, 535, and 565 nm. But the dichromat will be missing one of the visual pigments in the cones (say, the last), and be unresponsive in the related region of the spectrum (they are red-blind). In this case we have an explanation of the differences that occur in the structures in terms of the different spectral sensitivities that occur with the two systems. So there doesn't seem to be any reason why we should think there is something problematic with this kind of example.

There are two further points of clarification that it will be useful to make in relation to this. The first is that whether the same idea applies to other examples is not something that can be decided independently of considering the examples. Nothing I have said would enable us to say that there are no grounds for multiple realization in other cases merely because we have recognized the fact there are different levels of description available. The issues we are considering depend in part on the features of the structures, and cannot be decided merely by recognition of this

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fact. What this means is that in considering the examples we have to be sure that we know what the kinds are. We have to know what the realizing kind *P* is and what the functional kind *F* is because it all depends on details of the kinds involved.

Second, it is important to notice that whether the structural kinds are the same depends in part on the level of description that is used for describing the structures. Depending on whether we describe the structures at more or less specific levels of detail, we will get different structural kinds. I have suggested that at the appropriate level of description the structures we have discussed should be seen as falling under the same kind. However, we should observe that which kind it is correct to appeal to in this context is not merely a matter of decision. The fact that there may be different descriptions available by itself does not mean that we are free simply to choose some preferred description. In relation to this, we should see that the problem of identifying the appropriate structural kinds is also not solved by referring to the practice of researchers in the relevant field (merely letting them choose the level of description). Consider, for example, Bechtel and Mundale's recent discussion (1999) in which this suggestion is proposed. In their view they claim that the standard arguments for multiple realization depend on mixing different "grains" of description to produce the appearance of different kinds of structures with the same kind of function. The functions are described in coarse-grained terms and the structures are described in fine-grained terms. In reply to this, they suggest that the problem goes away when we recognize that "a common grain size is insisted on . . . in scientific practice" (1999, 179). I do not want to deny that the practice of researchers has an important role in understanding the issues; we need to understand how researchers approach the details of the structures and their concerns about what needs explaining. But I want to suggest that which level of description it is appropriate to appeal to is not decided merely by deferring to scientific practice. With the account we provided, which kind it is appropriate to appeal to is determined by the requirements that are imposed in giving the explanation. In the end we should recognize that there are explanatory requirements we described that have to be satisfied to determine what the appropriate kinds are and that these are relevant to the examples.

7. Conclusion. I have suggested that there is a plausible reply to the examples that have been presented. There are differences between the structures of the eyes we described that it may be useful to note for certain purposes. But the differences do not prevent us from providing common explanations of the structures at the appropriate levels. This is important to recognize because it helps us to be clear about the problem we have

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been considering. It seems to me that claims about multiple realization occurring in various examples have been hampered by a failure to get clear about what counts as different structural kinds realizing the same kind of function. Given the loose descriptions that are often offered of the structures, it is no wonder that deciding whether it has occurred has remained a difficult question to answer. The present account has attempted to explain the issues that are relevant for deciding when we have a genuine example worth considering, or, at least, to make more precise the conditions under which it should be said to occur. There are several points that I have tried to suggest in relation to this issue. The first is that we have to be careful in understanding how functional explanation works. There are constraints at work that will help us in narrowing down the kinds of structures that we should appeal to as realizing the functions. The second point is that understanding this helps us to see that which kinds we should be appealing to is not merely a matter of decision on our part or the part of researchers. There are features of the explanation being given that we can appeal to in the attempt to identify the relevant kinds. It is hoped that more attention to these points will be useful in dealing with the kinds of issues that we have been discussing.

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