A COMPARATIVE ANALYSIS OF ESFELD'S HOLISM AND O'CONNOR'S EMERGENCE

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ABSTRACT

Since philosophers have called upon the presence of both holistic and emergent properties to explain how a whole can be 'more than the sum of its parts', this project explores whether a given property may be described as both holistic and emergent. After presenting Esfeld's account of holism and O'Connor's account of emergence I argue that only top-down holistic properties could potentially be emergent. Because bottom-up holistic properties are instantiated by the parts of a whole instead of by the whole itself, they cannot introduce the form of downward causation which is O'Connor's most important criterion of emergence. Despite these findings, however, I note that these two accounts involve importantly distinct stories of the generation of their respective properties and, since no one property can be generated in two distinct ways, I conclude that, in the senses currently delineated by these authors, no property can be both holistic and emergent.

DEDICATION

For Mr. George Sangster – my pillar of strength and wisdom. Your natural talent for education and guidance has touched and inspired me.

I will miss you.

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CHAPTER 1: INTRODUCTION

This project is a comparative analysis of holistic and emergent properties designed to answer the following question: Given that philosophers have called upon the presence of both holistic and emergent properties to explain the sense in which a whole can be said to be 'more than the sum of its parts', is it possible that the two types of properties have anything in common and, in particular, is it possible that a given property may be both holistic and emergent? I conclude that only one of the two forms of holistic properties presented, namely top-down holistic properties, could potentially be emergent. Because bottom-up holistic properties are instantiated merely by the parts of a whole, and not by the whole itself, they cannot introduce the required form of downward causation and thus cannot be emergent. I note, however, that these conclusions are conditional upon the compatibility of the ways in which the emergent and holistic properties are said to be generated and, for reasons to be discussed in Chapter 4, their compatibility seems questionable. So I ultimately conclude that nether of the types of holistic properties presented can also be emergent.

As there are many different versions of holism and emergence available[1], generalizing about the relationship between all holistic and emergent accounts is not possible. Therefore, it was necessary to choose a particular version of each type of account in order to answer my question. I chose Michael Esfeld's (2001) account of

[1] A simple search in the Philosopher's Index gets over 900 hits for "holism" and over 400 hits for "emergent". Of course not all articles found would be relevant, but this should suffice to show that there is a large amount of information available and, inevitably, many different versions of each kind of account.

holistic properties and Timothy O'Connor's (2000a primarily) account of emergent properties because in each case the author provided a clear and detailed description of the properties in question. I would like to note that during my analysis of these two accounts, found in chapters 2 and 3 respectively, I focus on presenting each author's description of his type of property, instead of focusing on the correctness of each account. Thus, for the most part, I do not concern myself with whether or not holistic or emergent properties do indeed exist. Instead, I assume for the sake of the comparison that the properties described by each author are real, and I attempt to investigate what they are and how they exist. I then present a detailed comparison of these properties and draw conclusions about the compatibility of these accounts.

Before we begin this project, there are some background concepts which play a large role in the ensuing discussion, so it will be helpful to provide an introduction to them here.[2]

Levels:

For the purposes of this project I will adopt Wimsatt's (1976) description of levels, in which "levels of organization just are those places (in a space of properties) where the greatest densities of types of systems are to be found" as well as the greatest densities of interactions between those types of systems (p. 242). So a level is identified by the presence of a collection of objects which most commonly and naturally interact. For example, the fact that I, as a human, can causally interact with cars, trees, and other humans suggests that we may all be on the same level. The intuition that I cannot interact

[2] I acknowledge, but will refrain from engaging in, the huge amount of literature available on each of these topics. Instead I will focus on providing one clear notion of these concepts which we can use to further our discussion of holism and emergence.

with solar systems and molecules suggests that I may be on a lower or higher level (respectively) in relation to these things. Thus, Wimsatt points out that his characterization of levels lends itself nicely to the commonly identified levels of nature, the major landmarks of which are "atom, molecule, cell, organism, population", with some room for more fine grained distinctions in between (p. 215).

As for comparing the levels of objects, Wimsatt says, "intuitively, one thing is at a higher level than something else if things of the first type *are composed of* things of the second type, and at the same level with those things it interacts most strongly and frequently with or is capable of replacing in a variety of causal contexts" (p. 215). Thus, when I say that an object, *A*, is at a higher-level than another object, *B*, I mean that *A* counts as a basic unit at its level, but as a complex collection of parts at the lower-level on which *B* exists. Similarly, if a *property* exists at a level higher than another property, that simply means that the higher-level property is instantiated by a higher-level object and the lower-level property is instantiated by a lower-level object.

Regarding the significance of these levels, Wimsatt says that "we might take as real at a given level those properties which are reliably detected by an appreciable portion of the entities at that given level", and he says that "entities and things detected by them at different levels are equally real, and none is secondary, in its *reality*, to any other." (p. 242). Thus, Wimsatt argues that our traditional assumptions that the lower-level is more 'primary' and thus possibly more real are due to our bias of explanation – our tendency to explain things in terms of their parts rather than explaining parts in terms of the things of which they are constituents – and thus are not a true indication of the 'reality' of things at

higher-levels.[3] Thus I will assume that things and their properties can be ontologically robust regardless of the level on which they exist. It may turn out that some seemingly robust properties or objects on higher-levels are in fact 'nothing more than' collections of lower-level things and properties, but we need not assume that this is the case for all higher-level phenomena.

In summary, for the purposes of this project we will assume: a) that a given level of organization is roughly identified by natural collections of entities which interact with each other and detect similar properties; b) that something may be lower-level in relation to something else if it can be part of that thing or if other things with which it interacts may be part of that higher-level thing; c) that the level on which a property exists is determined by the level of the object which instantiates it as well as the level of the other objects which can detect it; and d) that anything at any level may be ontologically robust.

Reduction:

For the purposes of this project I would like to highlight a distinction between 'type-reduction' and 'token-reduction', which I believe mirrors the different senses of "reduction" often used in philosophical contexts.

By "type-reduction" I mean the process of identifying types of properties on a higher-level with types of properties on a lower-level. Once such identities are established (and the higher-level property type is thus reduced to the type on the lower-level), the higher-level types of properties are then often said to be 'nothing more than' those lower-level types of properties. This implies that type-reduction allows for a sort of "ontological simplification" because those types of properties on the higher-level are no

[3] For further discussion of this point see Wimsatt (1976), beginning on p. 243.

longer distinct from the types of properties on the lower-level (Kim, 1998, p. 215). For those who engage in theory reduction, type-reduction is involved in the necessary step of creating bridge-laws to translate discussions of higher-level entities to the discussion of lower-level ones, thus enabling one to explain what was thought to be higher-level phenomena solely in terms of a lower-level theory.

An example of this would be the reduction of 'temperature' to 'average kinetic energy'.[4] In this case, when an object has any property of the type 'temperature', say when a quantity of gas has the property of being 'being 0 degrees Celsius', that object actually has nothing more than a property of the type 'average kinetic energy', say 'being 273.15 degrees Kelvin'. Thus the higher-level type of property can be 'type-reduced' to the lower-level type of property and the world can be equally well described (at least theoretically) if discussion of the higher-level property type were eliminated altogether.

Alternatively, I intend "token-reduction" to highlight the process of identifying an individual token of a higher-level property type with an individual token of a lower-level property type. One must revert to such a form of reduction when all the tokens of a type of higher-level property cannot be identified with lower-level token properties of one type alone. This form of reduction can be seen as weaker than the first because it is harder to achieve ontological simplicity in this case. For, although each token higher-level property is 'nothing more than' a token lower-level property, there is no accounting for the unity of the higher-level type in terms of the lower-level. Thus, one could argue that eliminating talk of the higher-level property type would leave something out of a description of the world. This seems to allow these higher-level types of properties to maintain a sort of distinctness from the lower-level.

[4] For a more detailed discussion of this and further examples see Kim (1998), p. 216.

I admit that I am not sure of the sense in which these higher-level types are supposed to exist although it seems that this 'distinctness' of the higher-level types of properties does not entail that these types are ontologically distinct from the lower-level. For if all properties could at least be token-reduced, the world would still be composed of nothing more than lower-level properties. And if a type just is the collection of its tokens, then the higher-level type is nothing more than a collection of seemingly disparate lower-level token properties, and thus may not be a natural type after all. On the other hand, if we consider Wimsatt's (1976) description of the reality of higher-level phenomena, it also seems possible that there may be some robust sense in which such property types do still exist. I therefore will leave open the issue of how such higher-level types of properties may be ontologically robust.

An example of token-reduction could be the reduction a certain painting's instantiation of 'beauty'. One might say that this token instance of the property type 'beauty' can be 'token-reduced' to the physical properties which are instantiated by that painting, for example, 'having certain brush strokes', 'being so coloured', and so on. However, notice that a statue may also instantiate a property of the type 'beauty', but may do so by instantiating quite different types of physical properties, say 'having a certain texture'. Thus 'beauty', as a property type, cannot be reduced to a single type of physical property because there are multiple types of physical properties which may be identified with any token instantiation of beauty.

Lastly, I would like to point out that by describing a property as "ontologically irreducible" I intend to identify it as something which is neither type- nor token-reducible. Instead, this term is meant to highlight the fact that such a property has its own robust ontological status – for its property type cannot be identified with a type on the lower-

level, and no token instance of this property can be identified with a token lower-level property. Thus the most ontologically simple description of the world must involve reference to this property if it is to completely describe the world. For example, most people admit that whatever turns out to exist at the lowest physical level is ontologically robust in this sense. (Extreme physical reductionists would go farther and argue that *only* those things at the lowest level have such a status.)

As there seems to be a connection in the literature between these notions of reduction and the idea of 'realization' I will take a brief moment to discuss that connection here. We will rely on Kim's (1998) notion of realization and assume that if a higher-level property is 'realized' by some lower-level property, then an object's instantiation of the lower-level property is sufficient for its instantiation of the higher-level property. Kim further argues that in a particular type of system, the lower-level realizer property must be both necessary and sufficient for the instantiation of the higher-level property. However, because different types of systems may realize higher-level properties with different lower-level properties, in general a particular realizer is not necessary for the instantiation of a higher-level property.[5]

We will also assume that when a higher-level property is realized in this sense, then any powers of the higher-level property are just powers of the lower-level realizer property. This follows from Kim's (1995) Causal Inheritance Principle which states,

> If *M* [a higher-level property] is instantiated on a given occasion by being realized by *P* [a lower-level property], then the causal powers of *this instance of M* are identical with (perhaps, a subset of) the causal powers of *P*.
>
> (p. 355.)

[5] For further discussion of this see Kim (1998) especially p. 233.

Because a realized property has no powers over and above those of the lower-level property which realizes it, such a property can be reduced to its lower-level realizer.[6] Thus, in relation to type-reduction, one could say that the higher-level property type, such as temperature, is 'realized' by one type of lower-level property, such as average kinetic energy, whereas in token-reduction, a type of higher-level property, such as beauty, is 'multiply-realized' by properties of the lower-level that fall under more than one lower-level type, such as the various types of physical properties mentioned above. Thus, higher-level properties which are realized by lower-level properties are either type- or token-reducible to those lower-level properties.

Supervenience:

We will need to refer to the relation of supervenience when comparing the accounts of holism and emergence so I would now like to identify some facts about this relation. Kim (1990)[7] says that supervenience, in general, is a relation between two sets of properties which is usually made up of three separate components:

> *Covariance*: Supervenient properties covary with their subvenient, or base, properties. In particular, indiscernibility in respect of the base properties entails indiscernibility in respect of the supervenient properties.
> *Dependency*: Supervenient properties are dependent on, or are determined by, their base properties.
> *Nonreducibility*: Supervenience is to be consistent with the irreducibility of the supervenient to their base properties.[8]
>
> (p. 9.)

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[6] I acknowledge that this conclusion assumes that properties are differentiated on the basis of the causal powers they afford to the object which instantiates them, and I find this assumption reasonable to hold. For an explanation of this as well as further discussion, see the description of Kim's "Principle of Causal Individuation of Kinds" (1993; p. 326).

[7] Unless otherwise noted, all references to Kim in this section are to Kim (1990) thus the date will be omitted.

[8] Here Kim (1990) is referring to what he calls "derivational reduction" (p. 19), which is essentially traditional theory reduction and thus involves type-reduction as outlined above.

Kim goes on to explain that covariance is the most crucial component of this triad, no account can be supervenient without that component, and he identifies three versions of covariance: strong covariance, weak covariance, and global covariance, where each is weaker than the one before. With *A* considered to supervene on *B*, Kim defines strong and weak covariance as follows:

> *Weak covariance I*[9]: No possible world contains things, x and y, such that x and y are indiscernible in respect of properties in B ("B-indiscernible") and yet discernible in respect of properties in A ("A-discernible").
> *Strong Covariance I*: For any objects x and y and any worlds w_i and w_j, if x in w_i is B-indiscernible from y in w_j (that is, x has in w_i precisely those B-properties that y has in w_j), then x in w_i is A-indiscernible from y in w_j.
> (p. 10.)

The main difference between these two forms of covariance is that weak covariance only holds within a given world, so a world similar to ours in all base property respects may be completely different as regards supervenient properties, whereas strong covariance applies across all possible worlds, therefore it allows us to say that the supervenient "character of a thing is entailed, or necessitated by its [subvenient] nature" (Kim, p. 12). Thus we can see that the relationship between the supervenient and base properties involved in weak covariance has less force that that of strong covariance.

Kim defines the third, global form of covariance as one in which "worlds that are indiscernible in respect of subvenient properties are indiscernible in respect of supervenient properties" (p. 22). Because this form of covariance only involves global distributions of supervenient and subvenient properties, it does not tie any particular base property to any particular supervenient property and therefore also is considered to be

[9] Kim (1990) presents another version of both strong and weak covariance but states that the two versions (*I* and *II*) are "equivalent under certain assumptions concerning property composition" and thus I have chosen to present only one version of each (p. 10).

fairly weak. Kim thus identifies that in this sense of covariance, a world exactly similar to ours but for some small difference in its distribution of base properties could have a drastically different distribution of supervenient properties. Similarly, Kim points out that this form of covariance is even weaker than weak covariance because it allows for two objects in this world which are identical with respect to base properties to have completely different supervenient properties, thus this form of covariance has the least force.

With the types of supervenience identified, there is one further general point about supervenience that will be crucial in our comparison of Esfeld's holism and O'Connor's emergence: the assumed synchronicity of the supervenience relation. As it is not immediately clear that supervenience is a synchronic relation, I will provide three separate reasons to believe that it is synchronic and to believe that most people do hold this assumption about supervenience.

First of all, both O'Connor (2000a, p. 10) and Rueger (2000; p. 467) explicitly describe supervenience as a synchronic relation, meaning that there is no delay between the time at which an object instantiates a subvenient base property and the time at which it instantiates the property which supervenes on that base. Although he does not mention this assumption in his characterization of supervenience, Kim also seems to assume that supervenience is synchronic in a later discussion of the causal relevance of supervenient properties where he writes,

> Notice that given the simultaneity of the instances of *M* [the supervenient[10] property] and *P* [the base property] respectively, it is not possible to think of the *M*-instance as a temporally intermediate link in the causal chain from *P* to *P** [the base level effect]...For we would be allowing two distinct sufficient causes simultaneous with each other, of a single event.
>
> (1995, p. 354.)

This quote is taken from one of Kim's arguments against the coherence of downward causation, in which he argues that one can always explain what seem to be effects of supervenient properties as actually resulting from the base properties instead, because supervenient and base properties are always co-present. Regardless of the strength of this argument against downward causation however, it is clear that Kim thus seems to assume that supervenience is synchronic.

Further evidence for the synchronicity of this relation can be gathered by investigating just what the relation of supervenience is supposed to involve. Searle (1997) points out that the supervenience relation is traditionally seen as "a constitutive notion", where the subvenient properties of an object 'constitute' the object's supervenient property (p. 458). Thus a supervenient property is not a causal effect of some lower-level property, but is in fact part of a different sort of constitutive determinative relationship with that lower level.[11]

This constitutive nature of supervenience is apparent in the typical examples of supervenient properties, like the property of fragility. Kim (1995) says an object's fragility supervenes on the lower-level microstructure of the object which instantiates it

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[10] In the quote presented Kim is actually discussing properties which are physically realized, not supervenient properties. However, he does mention, earlier on in the chapter, that "the claim that mental states are physically realized arguably entails the claim that they are physically supervenient" and thus I have adapted his quote to fit our current discussion (Kim (1995), p. 342).

[11] Searle (1997) also presents a 'causal' notion of supervenience which he believes better characterizes the relationship between mind and body. Although it would be an interesting project to see how the accounts presented later in this thesis fit with such a novel notion of supervenience, we will not do so here. Instead we will only discuss the traditional notion of supervenience as that is the notion both Esfeld and O'Connor seem to have in mind when discussing this relation.

(p. 98). In this example, it does not seem to be the case that the microstructure exists and *then* the object becomes fragile, but instead that fragility seems to be instantiated by the object at the same moment that the microstructure is formed. And further, this synchronicity seems to hold because the object's micro-structure does 'constitute' its fragility in this case.[12] Thus we have further evidence that supervenience seems to be synchronic.

A third reason to believe that supervenience is synchronic is that such a restriction seems to be implied by Kim's principle of covariance. Recall that covariance is a necessary component of supervenience and that it must, therefore hold at all times between supervenient and base properties. This means that there can be no time at which a supervenient property changes yet the subvenient base remains the same, for that would mean there was indiscernibility of the base properties without indiscernibility of the supervenient properties – a direct refutation of Kim's description of covariance. Thus, if we assume that a property, *S*, supervenes on a lower-level property, *B*, then whenever a system has *B*, it must also have *S* and any differences with respect to *S* must coincide with differences with respect to *B*. Now, say that a difference occurs within a system with respect to *S*, in the sense that at time *t0* the system does not have the property, *S* and then at time *t1* the system does have *S*. According to the covariance requirement, the system also must have been different with respect to *B* at those times if the systems instantiation of *S* and *B* are to be reliably covariant. More specifically the system must not have had *B*

[12] We can note that supervenience, when considered as this 'constitutive' relationship, seems to fit well with the earlier described notion of 'realization', for one could say that an object's fragility is realized by its micro-structure. Kim (1998) in fact does argue that any property which is realized by properties on the lower-level also supervenes on those lower-level properties; however he mentions that a supervenient property need not also be realizable (p. 224). This connection between supervenience and realization also entails that some supervenient properties are type- or token-reducible to their base properties as well.

at time *t0* and must have had B^{13} at time *t1*. Thus since changes in supervenient properties must coincide with changes in base properties, we can see that the covariance requirement also seems to entail that supervenience is synchronic.

One may object to this last argument by pointing out that supervenience could potentially be described in terms of a 'diachronic covariance' where changes in the supervenient property must follow changes in the base property, but need not necessarily occur at the same instant.[14] I will concede that it may be possible to characterize supervenience in such a way that synchronicity need not hold, but as described above, the traditional notion of supervenience does seem to involve synchronicity and it is that notion which we will therefore assume in this project.

In summary, for the purposes of this project we will assume that supervenience is a synchronic 'constitutive' relation which holds between two families of properties that exist on separate levels of organization.

Downward Causation:

Our last background concept is downward causation which, according to Kim (1999)[15], simply "occurs when a higher-level property...causes the instantiation of a lower-level property" (p. 20). To provide an example of this, Kim invites us to imagine that a vase, with a mass of 1 kg, is dropped out of a window. The effects of this event include the displacement of air molecules as the vase falls and the scattering of vase and ground molecules as the vase shatters on impact with the ground. Thus, both physical

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[13] If *S* has multiple possible subvenient bases or is multiply-realizable, it must have had *B* or some other appropriate base property at time *t1*.
[14] Thanks to Phil Hanson for pointing out this possibility.
[15] Unless otherwise noted, all references to Kim in this section are to Kim (1999) thus the date will be omitted.

micro-particles internal and external to the macro-level vase are affected by dropping the vase out the window.[16] Kim is also careful to explain that the effects are indeed at a lower level (they occur among micro-particles) whereas the cause is at a macro-level (a 1kg vase dropping from a window) (p. 23).

However, Kim goes on to point out that various theorists, emergentists in particular, often mean more than just this general conception when they refer to downward causation. They in fact intend to identify 'reflexive downward causation' which Kim defines as occurring when "some activity or event involving a whole W is a cause of, or has a causal influence on, the events involving its own micro-constituents" (p. 23-24). He goes on to say that "we may call this reflexive downward causation, to distinguish it from the more mundane nonreflexive kind, involved in the example of the falling vase above, in which an event involving a whole causes events involving lower-level entities that are not among its constituents" (p. 24), but here Kim is obviously mistaken. He is clearly referring to the vase's displacement of the surrounding air molecules as it falls out of the window however, as I explained when presenting his example, the event consisting of dropping the vase out of the window will also result in micro-level changes to the vase itself. For example, the resulting shattering of the vase does, by all accounts, seem to be an effect involving lower-level entities that are among the vase's own constituents. That being said, although I believe Kim's "mundane" example is therefore more striking than he may believe, because it does involve reflexivity in his sense, I will not further engage in a discussion of this discrepancy here as it is not relevant to this project.

[16] Kim seems to often use "macro" to indicate higher-level phenomena, and "micro" to indicate lower-level phenomena and we will adopt his usage of these terms for the duration of this project. (See Kim (1995), p. 95 for a further discussion).

Kim goes on to identify two versions of reflexive downward causation. The first, synchronic reflexive downward causation, occurs when the higher-level property of an organism causes changes to the lower-level components of that organism at the same moment in time as the higher-level property is determined by that lower-level. The second, diachronic reflexive downward causation, occurs when the higher-level property uses its powers at a time later than the moment at which it is created. Note that it is this latter form of reflexive downward causation which will be most relevant in the following discussion.[17]

In summary, downward causation is causation that occurs from a higher-level to a lower-level and can involve an object's causing changes to its own constituents (reflexive) either at the same time as (synchronic) or at a later time than (diachronic) it is caused or determined by those lower-level parts.

We have now completed our background discussion and are ready to move on to a discussion of Esfeld's account of holistic properties. After that, we will engage in a discussion of O'Connor's account of emergent properties, then a comparison of the two accounts.

[17] I should note that Kim goes on to provide arguments for the incoherence of these reflexive versions of downward causation, but I will not address those objections as I do not believe they are relevant to our discussion here. First of all, Kim's objections are dependent on the assumption that higher-level properties supervene on lower-level ones. As our main interest in downward causation will be in relation to O'Connor's account of emergence, and as O'Connor does not share the assumption of supervenience between levels (as far as emergent properties are concerned), I therefore do not believe that Kim's objections apply to O'Connor's account. Kim's objections may turn out to be relevant to Esfeld's account of holism, a prospect which I will discuss in my concluding chapter, however there are further reasons to believe that the objections fail in that case as well. For the sake of brevity I will not argue against Kim's objections here but I will note that they should not be a concern for this project.

CHAPTER 2: ESFELD'S ACCOUNT OF HOLISM

In this chapter I will outline Esfeld's (2001)[18] general account of holism in hopes of coming to a clearer understanding of what it means for a system, or a property, to be holistic. Esfeld's account was chosen because he goes to great lengths to provide a general account which is meant to be suitable for any case of holism, regardless of the discipline from which it stems. In providing his account, he therefore attempts to unify accounts of holism from different disciplines, such as science and psychology, in order to identify what they have in common. Thus he dismisses the occasionally held view that holism describes a special category of 'spooky' mental phenomena, and he instead shows that both scientific and psychological phenomena can be considered holistic in the same sense. Thus he can conclude that "it is not holism in itself that distinguishes intentional states from the physical" (p. 305).

Before we begin discussing Esfeld's account, it is important to highlight the fact that this chapter is not intended to be an argument for the existence of holistic properties; that is a task for another project. Instead, the purpose is to explain, as clearly as possible, a coherent account of holism in hopes of coming to an understanding of the nature of holistic properties. With that in mind, let us now begin by investigating Esfeld's characterization of holistic systems.

Esfeld believes that there are families of qualitative properties which, when instantiated, make certain systems be *of* the qualitative kinds that they are. He also

[18] All references to Esfeld are to his (2001) thus the date will be omitted.

believes that there are similarly constituted families of properties which parts of such systems must instantiate in order to be considered 'constituent parts' of systems of those certain kinds.[19] None of the members of these 'constituenthood' families of properties must be essential properties in the sense that they must be instantiated for the parts to exist, however their instantiation is necessary for the parts to be considered constituents of that kind of system (p. 10). A further requirement of 'constituenthood' is that such parts must not only instantiate the 'constituenthood' properties, but must also be suitably arranged among the other parts in such a way that they collectively form that certain system. Holistic properties are then simply members of these families of 'constituenthood' properties which are unique because there are special conditions which must obtain in order for any part to actually instantiate them. Specifically, to instantiate a holistic property a part is dependent on there actually being other parts together with which it is arranged; the part cannot instantiate a holistic property when isolated from the system. Thus, it is necessary for a part to instantiate 'constituenthood' properties and to be arranged among other parts in a certain way, for that part to be considered a constituent of a system of a certain kind. And not only must holistic systems of certain kinds meet that requirement, but such systems also require that the constituent part be dependent on other parts to instantiate at least one of its 'constituenthood' properties, namely, its holistic property. Thus Esfeld formally characterizes holistic systems as follows:

> Consider a system of the kind *S* and its constituent parts. For every constituent of an *S*, there is a family of qualitative, non-disjunctive

[19] For the sake of brevity, I will refer to 'constituent parts' solely as 'parts' or 'constituents' throughout this chapter. Keep in mind this is a technical term which refers only to those parts of systems which instantiate the required family of characteristic 'constituenthood' properties.

> properties that make something a constituent of an *S* provided that there is a suitable arrangement.
> An *S* is holistic if and only if the following condition is satisfied by all the things which are its constituents: with respect to the instantiation of some of the properties that belong to such a family of properties, a thing is ontologically dependent in a generic way on there actually being other things together with which it is arranged in such a way that there is an *S*.
>
> (p. 15-16.)

Now we have a lot more to clarify about this definition. Specifically, we must better understand 'generic ontological dependence' as this dependence among parts is what makes a system holistic. In explaining this notion, I will also attempt to characterize this definition in terms of properties, instead of systems, so that we may more easily compare it to O'Connor's definition of emergent properties later in this project.

To say that the instantiation of a holistic property, by a part of a system, is ontologically dependent on the existence of other parts and their arrangement with the part in question is to say that the part in question would not have the holistic property it does if the companion parts did not exist and were not so arranged. It is in this sense that the relationship is ontological - whether or not the part in question actually instantiates the holistic property depends entirely on the existence of, and its arrangement among, the other parts in the system. Thus, for their existence, holistic properties are completely dependent on the structure of the constituents of a system. They are dependent in this way because it turns out that holistic properties just are the relations between these parts, thus the parts must exist and be arranged in certain ways for these relations to hold.[20] The dependence is generic because no particular other part needs to exist for a holistic property to be instantiated; various constituents of a system can be replaced yet the part in relation to them may still instantiate the holistic property in question (Esfeld, p. 8). Thus,

[20] A more detailed discussion of the sense in which holistic properties just are the relations between parts will follow further along in this chapter.

holistic properties are properties that depend, for their instantiation, on there being a system of some general set of constituents with a certain arrangement.

We can now identify the difference between holistic and non-holistic (or "atomic") systems. An atomic system is one in which a part of the system could have all its 'constituenthood' properties in isolation, regardless of whether or not that part was actually arranged within the system (p. 4). Esfeld's main example of such a system is a heap of sand. For an individual grain of sand to be considered a constituent part of a heap of sand that grain must instantiate a family of characteristic 'constituenthood' properties, such as having a determinable[21] size, mass, and chemical constitution. That grain of sand must also be appropriately arranged with other grains of sand, say within a certain spatiotemporal distance of each other, in order for the system of that kind to exist; for individual grains of sand spread out over time and space do not constitute a heap of sand. As we can now see, atomic systems actually fit with the first half of the general characterization of holistic systems presented above, for that part of the definition merely describes what it is to be a constituent of a system, and almost any system can be comprised of constituents.

The difference between holistic systems and atomic systems therefore lies in the second part of the definition. Again a holistic system is one in which a part's instantiation of at least one of its 'constituenthood' properties necessitates (in a generic ontological dependence sort of way) the existence of, and the part's arrangement among, the other parts with which it makes up that certain system. One of Esfeld's key examples

[21] By identifying the 'constituenthood' property as "determinable" Esfeld (2001) means that the part cannot have this property "simpliciter, but only in a way that admits of further specification" (p. 15). For example, a particular grain of sand cannot simply have mass, but will instead have some determinate mass, say 0.3mg.

of a holistic system is a person's system of beliefs. A belief, he argues, has certain characteristic determinable properties – such as meaning, confirmation, and justification – and in order for any one belief in that system to have, say, a determinate meaning, that belief must be arranged among the other beliefs in a certain way. He argues for this because he characterizes the meaning of a belief as the inferential role that belief plays within a person's whole system of beliefs. He defines this role as the other beliefs to which a person is committed, entitled, and precluded from being entitled when he or she holds that particular belief.[22] Since the belief's meaning just *is* its relation to all the other beliefs, the instantiation of that property of meaning could not occur without there actually being other beliefs with which that particular belief was arranged. Thus, as concerns its instantiation of one of its characteristic properties, namely meaning, a belief is ontologically dependent in a generic way on there actually being other beliefs with which it is arranged to form that system. Meaning is thus a holistic property and a system of beliefs is thus a holistic system, because it includes a holistic property among its 'constituenthood' family of properties.

[22] To argue for this, Esfeld accepts the Duhem-Quine thesis of confirmation which states that experience does not confirm or refute propositions taken in isolation, but only whole systems of propositions. It also states that there is no distinction between analytic and synthetic statements in terms of their immunity to revision based on experience. It follows from this that systems of language or, as Esfeld has extended it, systems of beliefs, are connected like a web, where each component is related to every other component in the web. Esfeld then argues for an account of inferential role semantics whereby the meaning of a single proposition or belief is the inferential role that proposition or belief plays within the whole system in which it is embedded. When combined with the Duhem-Quine thesis, the inferential role of any one belief can be extended to incorporate all the other beliefs in the whole system, leading to what Esfeld calls an open-ended inferential context. Thus the meaning of a belief consists of the collection of other beliefs to which the person is committed, entitled, and precluded from being entitled when that person holds that particular belief. Esfeld concludes that a belief's meaning is therefore that belief's particular relation to all the other beliefs within a person's whole system of beliefs. As the point of this chapter is not to confirm or refute Esfeld's definition of meaning, but to use it, as he does, to better understand his notion of holistic properties, I will not go further into this description than I have. I direct the interested reader to Esfeld (2001) chapters 2 and 3 for further discussion of such examples.

From this example we can again see that the special dependence described is generic. Part of Esfeld's argument for semantic holism in beliefs assumes that the meaning of a particular belief may be held constant while meaning changes are made to the rest of the system. This entails that no particular other beliefs must be part of the system for a single belief to have a determinate meaning; the requirement is just that there must be some collection of other beliefs which make up the system for the belief to continue to have meaning.[23] Thus, it is in this sense that the ontological dependence is generic, no particular other constituents are required; there exists merely the general requirement that there be other parts that make up the system.

Notice that the main difference between atomic and holistic properties is thus their dependence on the arrangement of the parts of the system. Whereas parts can instantiate atomic properties in isolation, they cannot instantiate holistic properties outside of being arranged with the other parts of the system. Thus, holistic properties are a special sort of relational property because they necessitate this generic ontological dependence between the parts. However, there are many properties that seem to require relations among parts but are not in fact holistically relational. Esfeld classifies some of these other relational properties as arrangement properties and the distinction between the two turns out to be relevant to identifying holistic properties. Thus, to better understand the distinction between these two sorts of relational properties, let us first look at Esfeld's definition of each. Esfeld defines a relational property as holistic

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[23] One might ask how the meaning of a belief can be held constant when changes are made to the rest of the system if the meaning is the relationship that belief holds to the rest of the system. Esfeld's account of meaning goes further than what was presented here and draws conclusions that tie meaning to social practices. In so doing, Esfeld accounts for consistency of meaning through changes in the overall system of beliefs. Due to the scope of this paper those arguments will not be presented here. Again, the reader is directed to Esfeld (2001) chapters 2 and 3 for further discussion of this point.

> if and only if it satisfies the following two conditions: 1) Instead of being an arrangement property, it belongs to the family of properties that makes something a constituent of [a system of a certain kind] provided that there is a suitable arrangement. 2) Nothing can have this property unless there actually are other things together with which this thing is arranged in such a way that there is [a system of a certain kind].
>
> (p. 16.)

Thus, a holistic property is a relational property that is not an arrangement property and that is ontologically dependent in a generic way on the arrangement of a system's parts. So we must now attempt to understand arrangement properties to learn why holistic properties are distinct.

Notice that one thing the above definition tells us is that arrangement properties are not members of 'constituenthood' families of properties. Instead, according to Esfeld, an 'arrangement property' is a relational property, the description of which can be reduced to a description of more basic properties of the part and a description of the required placement of the part within the system (p. 13). For example, one property a heart can instantiate is that of 'being a blood pump' and in order for a heart to be a blood pump the heart needs to be arranged in blood. This seems similar to the case of the meaning of beliefs because, in order for a belief to have a determinate meaning, it also needs to be arranged among other parts of its system, namely the other beliefs. So in both cases it seems that in order for the part to instantiate its property, each part requires the presence of other parts of the system. The important difference, however, is that the property of being a blood pump is 'descriptively reducible' to other, more basic properties of the heart, such as its chemical constitution and physical structure, in conjunction with a requirement that the heart be appropriately arranged within a system. And because of its 'descriptive reducibility', the heart's property turns out to be merely an arrangement property. Furthermore, once that property is descriptively reduced to the heart's more

basic properties, one can see that these more basic properties can be instantiated by the heart even when it is isolated from the system. Since it is in fact these more basic properties which enable to heart to be a blood pump, when it is appropriately arranged within a biological system, and since these more basic properties are no longer relational, in the sense that they can be instantiated by the heart even when it is isolated from the system, we can see that 'being a blood pump' was never a holistic property. For, the heart was dependent on the arrangement of the system to carry out its function but not to instantiate the properties necessary for that function. Thus, because the property of 'being a blood pump' is descriptively reducible and because the properties to which it is reduced do not require an arrangement of parts in order to be instantiated, neither the original property, nor the properties to which it was reduced, are relational in the holistic sense.

This obviously contrasts with the case of the meaning of beliefs. The meaning, or inferential role, of a belief just *is* that belief's relations to other beliefs. There are no more basic properties of a belief to which its meaning can be descriptively reduced thus we can say that the meaning of a belief cannot be a mere arrangement property. Since the beliefs are also ontologically dependent, in a generic way, on their arrangement with other beliefs to instantiate their individual properties of meaning, and since these meanings are not arrangement properties, they are therefore relational properties in the holistic sense. Thus Esfeld writes,

> By excluding from the mentioned family of properties those relational properties in which the arrangement with other things consists, we pick out the properties that underlie the arrangement. We are up to a substantial case of holism if and only if these underlying properties are relational as well – in the sense that one thing can have these properties only if there are other

> things together with which this thing is arranged in such away that there is [a system of a certain kind].
>
> (p. 13-14.)

In summary, arrangement properties are relational properties which turn out to be descriptively reducible to more basic properties of a part as well as a description of the arrangement of the part within a system, whereas holistic properties are relational properties which cannot be descriptively reduced because the properties themselves consist in their relational structure.

Esfeld points out that we can use 'descriptive reducibility' as a guide for testing whether properties actually are holistic, or whether they are merely arrangement properties. Thus he admits,

> if it were possible to reduce the description of types of beliefs to the description of types of brain states (or other physical states), the case of beliefs would be parallel to the case of the heart. Being a belief would be an arrangement property of the neural material that makes up the brain. This material has properties that its constituents can have in isolation, and these properties make that material exercise certain causal functions in case a suitable arrangement is realized.
>
> (p. 20.)

Since it is a possible way to tell holistic systems from atomic ones, we should attempt to clarify what Esfeld means when he speaks of 'descriptive reduction'. This will also help us to gain a clearer idea of the nature of holistic properties. To begin, let us consider the following passage quoted from Esfeld:

> Holism is incompatible with reductionism in an epistemic sense. But it is not opposed to what is sometimes called "ontological reductionism", namely the rejection of dualistic ontology and in particular the claim that there are no forces over and above those ones that are acknowledged in physics.
>
> (p. 21.)

First of all, as he seems to use the terms interchangeably, it seems that Esfeld intends both 'descriptive' reduction and 'epistemic' reduction to identify the same thing and it is my opinion that Esfeld's notion of this form of reduction fits with the type-reduction identified in the introduction to this project. Recall, this involves the reduction of types of things in a higher-level to types of things in a lower-level and, when used to form bridge laws, results in the ability to explain the higher-level phenomena in terms of the lower-level theories.

This interpretation of the similarity between Esfeld's notion of descriptive or epistemic reduction and type-reduction does seem to fit with Esfeld's earlier quoted remark. If we could describe types of beliefs in terms of types of brain states then he says that being a belief would be essentially 'nothing more than' being a certain brain state. However, as he has argued, Esfeld does not believe that belief types are type-reducible. That being the case, we must next determine how to make sense of the second quoted remark where Esfeld identifies that holism is in fact compatible with a further kind of 'ontological' reduction. I believe that we should understand this second form of reduction to be 'token-reduction', where individual instances of holistic properties are 'realized' by lower-level properties, but types of holistic properties cannot be accounted for in this way. Thus, I believe that by saying holistic properties may still be 'ontologically reducible' Esfeld is arguing that token holistic properties may still be reduced to token physical properties and thus that token holistic properties need not be additional components of the world's ontology.

This interpretation of his uses of "reduction" explains how Esfeld believes that his account of holism in beliefs is compatible with the claim that beliefs supervene on and are realized by physical properties and processes (p. 20), yet how holistic properties still

"cannot be taken into account by a description of the properties which the things that are the constituents of [a system of a certain kind] can have in isolation," namely, the lower-level properties (p. 23). For, although there can be no mapping of types of beliefs to types of brain states, individual token-beliefs may still be realized by token-brain states so, ontologically speaking, any particular instance of a belief may be reduced to a particular brain state. This reduction provides the lower-level with no added descriptive or epistemic power, but the world is still only comprised of physical components.

There is one last quote I would like to introduce in order to complete this discussion, as it identifies a further concern that may help us finally grasp the sense in which holistic properties exist. Esfeld writes,

> According to this proposal, it is an ontological matter whether or not something is a holistic system. This is not relative to the way in which someone chooses to describe a system.
>
> (p. 16.)

In saying this, Esfeld's aim is to prevent a further possible confusion about his account. If holistic properties can be 'ontologically reduced' to physical properties, though not 'descriptively reduced', then one may be tempted to conclude that the classification of a system as holistic is merely a useful way of describing things, but that it does not reflect how the world actually exists. The above quote is obviously designed to fend off such conclusions. I suggest that we understand the above quote, in the context of our above discussion, to entail that whether or not a system does have holistic properties depends entirely on the world's actually being set up in some way, say in such a way that there is a system of a certain kind constituted by parts with particular 'constituenthood' properties. So although any particular instance of a holistic property may be token-reducible, meaning that it is realized by some physical property, there still may be a holistic property

type with its own independent existence.[24] Thus, whether or not something is a holistic system is an "ontological matter" because whether or not certain type-irreducible higher level types of properties exist depends entirely on whether or not the systems, described at the lower-levels, have certain arrangements and relational structures which realize these higher-level types of properties.

We can now see that Esfeld has given us a fairly substantial definition of holism that helps eliminate a lot of properties that may have seemed holistic, from being so considered. For example, merely being functionally describable is not enough to make a system holistic, as we saw in the case of the heart's being a blood pump, but let us now look at another of Esfeld's examples. Consider that a traffic light is functionally defined as 'being a thing that controls traffic'. So in order to be a traffic light, a thing must fulfill this function, thus it seems that the thing depends on being part of a system of traffic in order to have this 'characteristic' property. However, it becomes clear that all the properties of the light which enable it to fulfill this function are present in the light before it is embedded in the system of traffic. Thus, 'being a thing that controls traffic' can be descriptively reduced to the non-relational properties of the traffic light – such as being a certain shape, colour, etc. – and its required arrangement within a system of traffic. Thus the functional property again turns out to be merely an arrangement property of the traffic light, and thus not holistic.

To drive this point home, let us look at a few further examples of how Esfeld's definition excludes other seemingly holistic properties. 1) Esfeld argues that 'being a

[24] Recall my concern from the introduction as to how to characterize the sense in which these property types continue to exist despite the reduction of their token components. The concern applies here as well, but we will again accept Wimsatt's (1976) characterization of the reality of higher-level properties and grant that their continued existence is at least a possibility.

family member in the biological sense' is not a holistic property because a person can have the biological properties which make them a human being without being arranged among other people (p. 19). If something instantiates these biological properties and is appropriately arranged within a system, it becomes a member of a particular biological family because of those non-relational biological properties and its suitable arrangement among other human beings. 2) Esfeld also argues that social roles are arrangement properties. For example., 'being a judge' is an arrangement property because this property can be descriptively reduced to the properties of being a rational human being, which include being human and having beliefs with determinate meanings, and being arranged appropriately within a social community (p. 13). 3) 'Being a planet' has sometimes been considered a holistic property for it seems to include the relations between celestial bodies and a sun.[25] However, when one investigates the 'constituenthood' properties required for being part of a solar system, one comes to realize that what makes a planet a planet, and thus a constituent of a solar system, are certain non-relational properties, such as its physical constitution and size, and the planet's arrangement among other planets and stars. Thus, 'being a planet' is also an arrangement property.

As we can see, none of the above properties are holistic because they are all 'descriptively reducible' to more basic properties of a part and a description of the arrangement of that part among the other constituents of the system. Recall that to be holistic, a property must be a member of the family of 'constituenthood' properties that make a part a constituent part of a system and the part which instantiates that property must be ontologically dependent in a generic way on its arrangement among other parts in

[25] Thanks to Jeff Pelletier for challenging me with this example.

order to instantiate the holistic property. Because each of the above properties turns out to be an arrangement property, each property cannot be a member of the 'constituenthood' family of properties. And because the above properties are 'descriptively reducible' to non-relational properties (with the exception of 'being a judge' which is reduced to a holistic property – 'having beliefs with determinate meanings'), we can see that no part is dependent, in the right sort of way, on the other parts for its instantiation of those arrangement properties. Thus none of the above is itself an example of a holistic property.[26]

Now that we've got a fairly firm grasp on the general definition of holism, we can identify the two varieties of holistic systems that exist. Both of these varieties fall under the general description, the difference between them lies only in the level on which the holistic property is instantiated.

The first type is called a bottom-up holistic system. In this type of system, it is the parts of the system which instantiate holistic properties. In regards to the property of having a determinate meaning, a system of beliefs is an example of a bottom-up holistic system. Recall that for Esfeld, the meaning of a belief is that belief's inferential role within the whole system of beliefs. A system of beliefs as a whole cannot have an inferential role, so it is improper to say of such a system that it has meaning. Instead, each individual belief has its own property of meaning, and the system as a whole has meaning only indirectly insofar as it is a collection of meaningful parts. Thus, the bottom level of the parts is where the holistic property is instantiated.

[26] Notice that even in the case of 'being a judge', that property itself is not holistic, despite the fact that it may be descriptively reduced to a holistic property.

Esfeld suggests that bottom-up holistic properties may be similar to Fodor's and Lepore's (1992) anatomic holistic properties, which they define as "properties such that if anything has them, then *lots* of other things must have them too" (p. 2). The emphasis on "lots" is meant to distinguish holistic properties from merely anatomic ones, where "a property is anatomic just in case if anything has it, then at least one other thing does" (p. 1). As should be evident, this description seems to hold for the meaning of a belief – for any one belief to have a determinate meaning, lots of other beliefs must have determinate meanings as well, for there must be a whole system of meaningful beliefs for any one belief to play an inferential role. Esfeld notes, however, that his account is compatible with there being different families of 'constituenthood' properties for each constituent of a system (p. 14). For example, the properties which organs must instantiate in order to be constituents of a biological system may vary depending on the organ in question. Although it's not clear that biological systems are holistic, this should highlight the fact that not all constituents of a system need to instantiate a similar holistic property in order to be constituents of that system. Thus, Esfeld's characterization of bottom-up holistic properties, though compatible with Fodor's and Lepore's description of anatomic properties, may still turn out to be different in this respect.

The second type of system, a top-down holistic system, is one in which the holistic property is instantiated by the whole itself. In this case, none of the parts have the property individually; they do so only insofar as they are constituents of the system as a whole, however, the property of the whole "specif[ies] a differentiation within the whole by introducing constituents of the whole and thus including relations among the constituents" (p. 24). For example, Esfeld argues that one of the characteristic properties

of beliefs, namely confirmation, can be considered a top-down holistic property. He writes that,

> The logical relations among the constituents of a system of beliefs propagate confirmation...from one belief to other beliefs. If there is no separation between synthetic and analytic beliefs, the logical relations among the constituents of a system of beliefs propagate confirmation to the system as a whole. Consequently, (a) strictly speaking, it is the whole system of beliefs that has the property of confirmation, but (b) the property of confirmation of the whole shows how its constituents are related with one another as regards confirmation.
>
> (p. 37)

Thus we can see that in top-down holistic systems the parts are still ontologically dependent in a generic way on each other for the whole to instantiate the holistic property; however, strictly speaking it is only the parts taken together, or the whole, which instantiates a top-down holistic property. As top-down holism is a slightly more confusing notion, let me also present another example.

Esfeld describes entangled quantum systems as holistic. He argues that position, momentum, and spin in any direction, as well as rest mass and charge, are all members of the family of properties that make a quantum system a system of its qualitative kind. However, he argues that scientific evidence indicates that quantum systems which are entangled cannot have position, momentum, or spin in any direction independently of their being considered as components of a larger entangled system. Instead, the individual systems jointly instantiate the properties of relative distance, total momentum, and total spin, where each of these properties are understood as "correlations between probability distributions of local observables", where the "local observables" are the position, momentum, and spin in any direction, of each part (p. 257). This means that, for instance, instead of each system of the entangled pair having their own value for spin in

any direction, there is an overall property, total spin zero, of the larger entangled system which determines that one of them, say, has a spin upward and the other a spin downward. Thus Esfeld says,

> in the case of entanglement, only the pure state of the whole completely determines the local properties of the parts and their relations (to the extent that these properties and relations are determined at all in quantum physics). It is this point that we need to make a case for holism.
>
> (Esfeld, p. 242)

So, although the property of, say, spin in any direction is a property that each quantum system must instantiate in order to be considered a constituent part of the entangled quantum system, no constituent can instantiate this property individually. Instead, each can only instantiate its property when considered in the context of the whole entangled system. Since each individual constituent of an entangled quantum system can instantiate these 'constituenthood' properties only when taken together as a whole, this is therefore a case of top-down holism.

A further interesting point that this example highlights is the fact that, in order for systems to be considered holistic, only at least one of the 'constituenthood' properties needs to be holistic – not all. So although the family of 'constituenthood' properties in the case of quantum systems also includes non-holistic properties, i.e., rest mass and charge, because it also includes holistic properties, quantum systems are thus holistic systems. This possibility means that holistic systems can come in varying degrees. A system may include all holistic 'constituenthood' properties, and thus be, say, completely holistic, whereas another system may only be holistic relative to a single 'constituenthood' property. So, we can say that the former system is 'more holistic' than

the latter. This point will not play a large role in our later comparison; however it is still interesting to note that it is a part of Esfeld's account of holism.

Esfeld notes that this second form of holism may be similar to a different characterization of holism that Fodor and Lepore (1992) identify, namely, a characterization inspired more directly by Quine where whole systems are considered to instantiate holistic properties instead of the individual parts.[27] Thus Esfeld seems to have successfully captured previously distinct forms of holism under one generic conception which can then be broken down into these two identified forms. He has thus created a unified general account of holism.

In summary, we have learned that a holistic property is a special member of the family of 'constituenthood' properties which a part must instantiate to be a constituent of a certain kind of system. The holistic property is special because, for a part to instantiate it, the part is ontologically dependent, in a generic way, on its arrangement among other parts of the system. Again, this dependence is necessary regardless of whether the holistic property is instantiated by a part or by a whole system, because in both cases the holistic property just is the relation among the parts of the system, and thus in both cases the property cannot be instantiated in isolation from the system's parts. And although we learned that holistic properties may be realized by physical properties, we also saw that holistic properties remain type-irreducible to types of properties at that lower-level. Thus, despite possibly being physically-realized, holistic property types seem to have their own sort of independent ontological existence.

[27] For further discussion of this point see Fodor and Lepore (1992) p. X and Esfeld, p. 25.

CHAPTER 3: O'CONNOR'S ACCOUNT OF EMERGENCE

The purpose of the following chapter is again not to convince you to believe that emergent properties exist, but only to explain clearly Timothy O'Connor's (2000a primarily) account of emergent properties. O'Connor's is a particularly interesting account to study because it is stronger than many others; the properties O'Connor describes are ontologically robust because they carry completely novel, basic causal powers. This makes his account more interesting to those who wish to reify mental properties, but more difficult to swallow for those who are ontologically conservative. Another concern for those looking to accept his account is that that O'Connor's account of emergence was not created independently of the phenomena to which it is meant to apply. Instead, he took as jumping off points two paradigm candidates for emergence, mental phenomena and free agency, and tried to isolate what we must intend to identify when we appeal to accounts of emergence in these cases. So, O'Connor's account does seem to be tailor made to explain these phenomena and it seems to have, as a goal of its creation, a certain commitment to the status of emergent phenomena built in. Because of these facts, one may already feel compelled to question the plausibility of his account. If this is true of yourself, I ask that you refrain from doing so just yet. For, beyond these questionable beginnings, O'Connor's account does also provide us with a coherent picture of the possible nature of emergent properties and thus he leaves us with a better understanding of these complex phenomena. So, although O'Connor's method and primary assumptions may be a concern for anyone interested in eventually accepting his

account, remember that these sorts of concerns are not our focus here. Instead, our focus is on what is interesting about his account, namely that it describes to us the nature of emergent properties. Thus, if we follow his account, we come out with a nice understanding of what an emergent property should be, and we can concern ourselves later with whether anything seems to actually be emergent.

With those prefatory remarks out of the way, and our goal in this analysis clear, let us begin our discussion of O'Connor's account of emergent properties. O'Connor defines emergent properties as follows:

A property is emergent if and only if:

a) The property is a "qualitatively new, macro-level feature" of the world (2000b, p. 111);
b) The property is a "causal consequence of the object's exhibiting some general type of complex configuration" (2000a, p. 8);
c) The property is simple or non-structural; and
d) The property has a novel downward causal influence (on the system from which it emerged).

To begin our investigation of emergent properties let us start with the first criterion of this definition: the qualitative novelty of emergent properties. O'Connor says that an emergent property will have a nature that is qualitatively distinct from the nature of any property which exists on a level lower than the emergent property itself. As an example, O'Connor points out that the nature of mental properties necessarily involves their being only subjectively accessible. In other words, mental properties cannot be objectively accessed but can only be known via a person's direct experience of them. Since no such restriction on access seems to be true of lower-level physical properties, this subjective nature seems to appear 'out of nowhere' when mental properties are introduced to the world, and thus O'Connor describes these mental properties and novel qualitative natures in general, as "ontologically sui generis" (2000a, p. 8).

It seems that the major role played by this part of the definition is to assist with the identification of emergent properties, for the detection of a property which is qualitatively novel seems like a first step in identifying emergent properties. However, there are many more qualitatively novel properties than there are emergent ones, so this criterion alone is not sufficient for a property's being emergent. For example, I believe that O'Connor would not consider 'solidity', 'redness', or 'beauty' to be emergent properties (due to their complexity, a concern I will discuss later) although they do seem to be a candidates for qualitative novelty. So for now it will suffice to note that emergent properties will always be qualitatively novel.

Once these novel qualitative natures are introduced, some philosophers begin to question how such novelty could even come into existence, seemingly out of nowhere. A common response to these concerns is to appeal to supervenience as an explanation by saying that such novel natures are determined by the subvenient properties and thus not just mysterious additions to the world. Although O'Connor also followed such a strategy in earlier accounts[28], he has since decided against taking that route. Instead, O'Connor has developed a story of how an emergent property could be the effect of a natural and physical causal process as well as how the emergent property, once instantiated, could be said to continue to depend on lower-level physical properties for its existence, without supervening on the properties at that lower-level. So let us now take a look at this causal story.

O'Connor proposes that, along with the established causal powers of physical properties, there may also be a 'tendency' to generate emergent properties present in some microphysical particles. He describes this tendency simply as a disposition of the

[28] See, for example, O'Connor (1994).

physical properties to bring about a state of affairs that includes, among its constituents, an emergent property (2000a, p. 8). He also encourages us to assume that this tendency is 'incomplete' in each particular physical property, but 'jointly effective' when all the properties come together in a sufficiently complex system. Such an individual ineffectiveness, he argues, would explain why we have not yet identified any physical property's tendency to generate emergent properties. Since scientific studies primarily investigate microphysical properties in fairly simple systems, and since the effects of these extra causal powers would not be apparent in such systems (due to the simplicity of these systems), it is not surprising therefore, that the tendency to generate emergent properties would not yet have been identified as a fundamental causal power of any individual microphysical part. Thus O'Connor calls for further scientific study of sufficiently complex systems to determine whether such causal powers do exist. Although his hypothesis does seem merely convenient, I believe that he is correct in pointing out that such a story is not logically impossible; it is a worthwhile empirical question whether any microphysical part has such tendencies. Therefore, at least for the purposes of this exposition, we can be satisfied with O'Connor's possible explanation of the appearance of emergent properties, and we can note that, in one sense, emergent properties are just ordinary effects of complicated physical causal processes.

As mentioned, O'Connor makes a point of distancing himself from countless other emergentists who rely on supervenience to explain the determinative relationship between physical and emergent properties. It is not clear why he so strongly desires to separate himself in this way, but one guess is that it allows him to avoid objections often raised against the causal efficacy of emergent properties, which are only likely to be effective if one's account is based on the assumption that emergent properties supervene on physical

ones.[29] So, in abandoning supervenience, O'Connor may simply be trying to avoid such objections to downward causation, and this may be necessary, seeing as downward causation does play a large role in his account of emergence. Whatever his motivations are for rejecting supervenience, however, it may still be helpful to identify how O'Connor believes his account is different from those involving supervenience, insofar as this helps us to understand better the causal relationship he is actually proposing in his account. So let us now turn to a brief description of the way he describes this difference.

O'Connor defines supervenience as "a synchronic relation between families of properties" where "[t]he family of emergent properties would supervene on the family of physical properties just in case having an emergent property implies, of causal necessity, (1) that an object has some physical properties and (2) that its having any specific set of physical properties suffices to determine which, if any, emergent properties it has" (2000a, p. 10). As we can see, this seems to fit well with Kim's (1990) previously introduced definition of supervenience. Now, O'Connor believes that his causal story is importantly different because the form of causation he appeals to is not synchronic and it does not meet the second principle of the above definition; thus it denies the general principle of covariance which states that one can have 'no higher-level property difference without a lower-level property difference'. I will describe his explanation for both of these claims in turn.

O'Connor first argues that the emergent-generating causal processes that he posits are not synchronic. Instead, the emergent property is supposed to appear at a time later than the initial existence of the complex configuration of micro-particles. For example, O'Connor provides an explanation of the generation of an initial emergent property while

[29] See Kim (1999) or Kim (2000) for such objections to downward causation.

laying out a possible emergent causal story. In his account, *E* represents an emergent property, *P** represents some general type of complex configuration of a portion of a neurophysiological system, *H*, and O'Connor is discussing the change from time *t0* to time *t1* in which an emergent property is generated. He says, "*E* is absent at the first time, since *P**'s obtaining at *t0* causally determines not what will occur at that very time, but immediately thereafter. So at the first instant of its [*P**'s] instantiation in *H*, *H* will not bear *E*" (2000a, p. 11). O'Connor's story thus assumes that regular physical causal processes, or those involved in the generation of emergent properties at least, bring about effects at a time later than the initial cause's existence. Thus, in accepting his hypothesis that emergent properties are the result of regular causal processes, we come to see that the causal process that leads to an emergent is diachronic, not synchronic like supervenience.

It is interesting to note that this diachronicity alone may be a significant point of distinction between emergent properties and other, non-emergent macro-properties which are merely 'resultant', 'additive', or 'structural', as they are often called in the literature. For it seems that other macro-properties, such as the mass of a book, do synchronically arise out of the complex systems to which they belong. The instant a whole book exists, so does its mass of, say, 2 kg. Not surprisingly, these other macro-properties are also often considered to supervene on lower-level properties and are therefore also said to be constituted by the properties of the lower-level parts of such systems. So, on O'Connor's account, instead of being this synchronic instantiation of a macro-property, an emergent property is truly a causal effect which comes about at a time later than the conditions which cause it and is thus is clearly identifiable as distinct from other, supervenient, macro-properties.

O'Connor further argues against the supervenience of emergent properties on lower-level ones by pointing out that his reliance on a causal story implies that there *could* be emergent differences without physical ones and thus, that in such a case, his story would not fit with the second part of his definition of emergence. O'Connor provides two arguments for this conclusion.

O'Connor first attempts to explain how his account denies the second part of his definition of supervenience by arguing that it would be consistent with his causal story if the particular emergent which results from certain causal processes is not necessarily determined only by the physical properties of the system to which it belongs. He describes how two physical systems comprised of the exact same physical components and properties could result in two different emergent properties, given a "suitably fortuitous" change in the environmental influence on these systems (2000a, p. 11). I believe this argument fails, however, because this difference could merely result in our having to include the environment in a description of the subvenient base of any emergent property. This addition would mean that the subvenient base is wider or more global, but it could still play the same role as regular subvenient bases in an account involving supervenience. In other words, the supervenience motto, 'no emergent difference without physical difference' could still be upheld – the physical difference would just include reference to the environment.

In his second argument O'Connor argues that if causation turns out to be probabilistic and if emergent properties are the results of regular causal processes, then it is possible that different emergent properties may result from the exact same physical state, due to variations in the probabilities of the outcomes which could be caused by those physical states. For example, if emergent properties *E1*, *E2*, and *E3* were all

possible effects of some physical state, *P*, for which there were certain probabilities, then it would be entirely possible for *E1* to be the effect of *P* in one instance, and for *E2* to be the effect of *P* in another. This would contradict the principle of covariance for there would in fact be an emergent difference without a physical difference. Even if causation was probabilistic however, traditional supervenience would continue to be the same 'constitutive' relationship and thus the general covariance principle would still need to hold between supervenient properties and their base properties. Thus the fact that on O'Connor's account the possibility of probabilistic causation would allow for a visible distinction between supervenience and his form of causation serves to highlight the way in which the two accounts are distinct. So if causation turned out to be probabilistic and if emergent properties are indeed the result of the causal tendencies of physical properties, then it does seem that the relationship between emergent properties and physical ones could not be describable in terms of supervenience as we traditionally understand it.

Therefore, if we accept O'Connor's account of how emergent properties are generated, then we can accept that the causal relationship between emergent and physical properties is not synchronous, that the physical state of the system alone is not necessarily enough to fully determine the particular emergent that will be generated, and that the causal process by which emergent properties are generated is indeed distinct from the determinative relation of supervenience.

It should now be somewhat clear how these emergent properties are to come about, but perhaps it is not yet clear enough how these emergent properties would continue to depend on physical properties for their existence. As this seems important to explain, and as we can no longer appeal to supervenience to help us, I would like to propose the following explanation of this existential dependence. In describing the

generation of emergent properties, O'Connor states that "it takes the right threshold degree of complexity for those tendings, present in each micro-particle, to jointly achieve their characteristic effect, which is the generation of a specific type of holistic state" (2000a, p. 9). Notice that O'Connor describes the resulting state of the system as 'holistic'. By this he simply seems to mean that the emergent property belongs to the system as a whole and not, strictly speaking, to any individual parts. Such an interpretation does seem to reflect how we often speak of emergent properties. Notice, we often describe the system as a whole as instantiating emergent properties, for example, we say 'of a whole person' that she has certain mental states, not that her brain has a thought or a sensation. If my interpretation is accurate, I believe this would help to explain how the emergent property continues to be dependent for its existence on the collection of microphysical parts. For, if an emergent property is truly instantiated by a whole system, and not any of its parts, then the emergent property depends on the system's parts for its existence only insofar as the whole system depends on its parts for its existence. To clarify this, let me say a bit more about this last point.

We can clearly understand how a whole system would cease to exist given sufficient restructuring of the parts of which it is comprised. For example, if we remove all the people from a society, the society ceases to exist, and if we remove all the molecules from a table, the table ceases to exist.[30] Now, if the emergent property belongs to the system as a whole and the whole ceases to exist, then it seems to follow that the property which is instantiated by the whole would also cease to exist. Thus, any significant change to the system could lead to the termination of the emergent property's

[30] I do not wish to engage in a discussion about the acceptable and detrimental levels of change allowed for continued existence, so I hope that the general point suggested here is clear.

existence because it would lead to the dissolution of the whole itself. I believe that it is in this indirect sense that an emergent property continues to depend on the physical properties of the parts for its existence.

One might be tempted to argue that this dependence entails that the emergent property supervenes on the lower-level, but I caution against this. I may concede that the existence of the whole system supervenes on the relation of its parts, but this does not entail that the instantiation of any macro-property of that system must also supervene on those parts (and their properties). For the instantiation of a macro-property necessitates the existence of a macro-object, but it need not be 'constituted by' that macro-object nor by any of the object's properties, parts, or properties of those parts. Thus this existential dependence does not entail that emergent properties supervene on lower-level ones.

In summary, according to O'Connor emergent properties are causally generated by, though not supervenient upon, the properties of regular physical particles and the continued existence of emergent properties does depend on those physical properties and the parts which instantiate them. But emergent properties are only indirectly so dependent, insofar as the whole system depends, for its existence, on the continued relation of those physical parts.

Now that we've learned a bit about the nature of emergent properties and how they are supposed to come about, we can begin to clarify just what is unique about these properties. O'Connor's third requirement, that emergent properties be simple, is a very important point. Intuitively we can understand the classification of a property as simple to mean the property is basic, or not made up out of any other properties. To further clarify the definition of simplicity, however, we must identify what simple properties are

not. O'Connor does this by contrasting simple emergent properties with 'structural' macro-properties, which he defines as follows,

> A property, S, is structural if and only if proper parts of particulars having S have some property or properties not identical with S, and this state of affairs is constitutive of the state of affairs of the particular's having S. (2000b, p. 109.)

Thus, structural properties are said to be 'nothing over and above' the combination or summation of the properties of the parts which make up the object, hence they are sometimes referred to as 'resultant' or 'additive' properties as well. Consider the following example to help solidify this point. An object's property of 'having a mass of 2 kg' is a structural macro-property of the whole object since, although no individual part of the object has the particular mass of 2 kg, that object's mass is merely, roughly speaking, a combination of the masses of all the individual parts of the object. We can thus say, of this structural macro-property, that it is nothing 'over and above' the masses of all the parts and that it is 'constituted by' or made up of these properties of the parts of the whole object. On the other hand, simple properties, whether macro or not, are not constituted by anything. They have no parts and they are not combinations or summations of other properties; again, they are basic properties in their own right.

It is important to note that this is the point at which O'Connor seems to really separate himself from some other emergentists. Whereas most emergentists would agree that the 2 kg mass of an object is not an emergent property, some emergentists would not deny that the object's mass is emergent *because* it is constituted by other properties. Instead, it seems that the problem some emergentists have with this property is that the object's mass is constituted by other properties of the same kind, the masses of the object's parts. In other words, what deters some philosophers from classifying certain

properties as emergent is not that they are structural per se, but that they are constituted by properties of the same kind as the emergent property itself. Therefore, some philosophers do allow for structural emergent properties, as long as the emergent properties are constituted by properties of kinds distinct from their own. For example, Searle (1997) classifies the property of 'solidity' as emergent or, to use his terminology, as a "causally emergent system feature" (p. 451). He says that, unlike mass, solidity cannot be deduced from the knowledge of the object's parts or their arrangement and that is what makes it emergent. However, Searle's is a weaker form of emergence, for he admits that an object's solidity can be "explained in terms of the causal interactions" among that object's parts (p. 451).[31] So Searle seems to be identifying a set of causal interactions with the property of solidity, and thus in effect arguing that solidity is indeed constituted by these causal interactions. Thus he seems to allow for structural emergent properties, so long as the properties of which the emergent is constituted are of a distinct kind from the emergent property itself.

O'Connor, of course, would disagree with Searle's classification of solidity as emergent. Although solidity may meet some of the requirements of O'Connor's definition (for example, solidity may be a candidate for qualitative novelty), the fact that solidity is constituted by the causal interactions of an object's parts, and is therefore structural, would immediately exclude it from being emergent in O'Connor's sense.

This discussion highlights a point we discussed earlier, so I'd like to take a moment to make the connection explicit. Notice that we have another reason to suspect

[31] Searle (1997) in fact believes that this causal form of emergence is akin to a new causal form of supervenience. He also goes on to identify a stronger sense of emergence which requires that the emergent properties have causal powers which are not explainable in terms of causal powers of the objects parts and which, therefore, is in fact more like O'Connor's account. However, Searle doubts that anything actually is emergent in that stronger sense. As the purpose of describing Searle's account is merely to contrast it with O'Connor's, I will not presently pursue either of these topics any further.

that solidity is not emergent: it has something in common with mass that an emergent property does not – supervenience. Solidity does seem to supervene on the microstructure of an object, in the traditional sense we are assuming in this project[32], because at the very moment that the particles of an object come together in the right sort of way, that object will become impenetrable, hence solid. This is true primarily because the object's solidity is constituted by that object's micro-structure. Thus not only is solidity structural, but is also seems to be synchronically supervenient upon properties of the lower-level, and thus may truly be eliminated as a candidate for emergence.

Now, I described this simplicity criterion as important for O'Connor's account, not only because it is a point at which his account of emergence is distinct from others, but also because it leads directly to the criterion of novel causal influence. In describing emergent properties as simple and therefore as not constituted by any other parts, we can see that emergent properties are to be understood as 'fundamental' or 'ontologically basic' features of the world. This may seem strange because emergent properties are macro-level properties, but should seem less so if we consider that these properties are the most basic properties on a new level of complexity in the world, i.e. the level of 'wholes'. For, emergent properties are properties which belong directly to these wholes themselves.

It follows, then, from their ontological novelty that emergent properties would bring with them new, ontologically basic causal powers. For if these new, ontologically basic properties had powers that other properties had, they would have to be either the same as those other properties, so not new, or constituted by those other properties, so not ontologically basic. Emergent properties, by definition, can be neither of these two options, and as there seems to be no point in discussing epiphenomenal properties,

[32] Again, we will be ignoring Searle's (1997) newer sense of causal supervenience.

O'Connor concludes that emergent properties do in fact provide the wholes which instantiate them with ontologically basic novel causal powers.

O'Connor then argues that the introduction of these novel causal powers will allow the whole system's behaviour to be 'fundamentally altered'. And in order to influence the whole system in such a way, he argues that the emergent property will have to bring about changes on a level lower than the one in which it exists. Because the whole is made up of the lower-level parts, there is nothing the whole can do without involving those parts in some sense. Now we can see how acquiring a simple property entails that the system also acquires ontologically basic novel causal powers, and we can see why these powers must be able to be exerted downward into the system from which the novel property emerges.

Now that we understand how we come to the introduction of novel causal powers, let us try and understand just how these new powers are supposed to work.[33] There are three main quotes from which I would like to tease out just what is unique about emergent causal powers:

1) "The difference that emergence makes is that what happens transcends the immediate, or local, interactions of the micro-physics" (2000a, p. 12).;
2) "What [the presence of an emergent property] does allow is a stable set of processes giving rise, at certain critical junctures, to a somewhat different order of affairs via 'top-down' controlling features" (2000a, p. 16).; and
3) "In contrast to the operation of an ordinary structural macro-property, such as the mass of this book, whose causal influence occurs through the activity of the micro-properties that constitute it, a structurally simple property bears its influence in a direct, "downward" fashion on the object's microstructure" (2000b, p. 111).

Let us first try to understand the fact that emergent properties bring about a "different order of affairs" (quote 2). This seems to mean that if a physical system

[33] Again, I am, admittedly, leaving out a discussion of the coherence of the notion of downward causation because I do not believe that Kim's (1999) objections to downward causation apply to O'Connor's account.

instantiates an emergent property, then that system's future effects can be different from what they would have been had that macro-property not come into existence. In other words, based only on the information provided by basic physical laws, one would not necessarily be able to accurately predict the future behaviour of a system with an emergent property. Thus, as we have seen, the emergent property must follow some new, fundamental laws, and one therefore must appeal to these laws, as well as the basic physical laws, in order to fully describe the behaviour of systems with emergent properties.

The rest of the second quote appeals to "'top-down' controlling features" and the other two quotes appeal to transcending "the immediate or local, interactions of the micro-physics" and bearing influence "in a direct, "downward" fashion on the object's microstructure." I believe that these phrases are each attempts at describing a similar notion, which I suggest should be interpret as follows: Instead of only indirectly bringing about effects *in* a whole object via some causal chain that leads through the parts, a simple emergent property can directly influence the whole system *as* a whole, with no need for the intermediary part-level steps. In other words, with the introduction of an emergent property, the system can act *as* a whole, instead of only being able to act indirectly as a collection of individual parts.

This interpretation is supported by the discussion of Wimsatt's (1976) notion of levels, presented in the introduction to this project. That discussion informed us that levels are identified by natural collections of objects that interact and detect similar properties. For something to exist at a given level then, it must be endowed with some causal 'force' of its own so that it may interact with other objects at its level. If all of the properties of a whole are structural and if such structural properties are made up of

properties of the system's parts, then the whole does not seem to have any causal force of its own, and it therefore does not seem to be able to interact with anything *as* a whole. Thus, it seems that only the parts have any causal force in such a case. On the other hand, when a system acquires an emergent property, the whole acquires a simple property which, since it is not constituted by lower-level properties, seems to hold its own place in the higher-level and thus provide the whole with its own causal force. In such cases then, the whole can act *as* a whole in its own right.

From the fact that the whole now has its own power, it follows that the whole can truly causally interact with other such wholes, thus securing its position on its own higher-level. We can thus understand the way a whole acts *as* a whole as its acting *as* a basic unit on its own level. Thus we can understand how emergent properties allow for causes that are 'ontologically basic' and how these powers can rightly be said to 'fundamentally alter' the behaviour of the system which instantiates the emergent property, for we can now see that the presence of an emergent property allows the whole system to play a significant role in future chains of events. It is in this way that the emergent property 'transcends the immediate, or local, interactions of the micro-physical parts' and 'bears its influence in a direct, "downward" fashion on the object's microstructure', and it is in this way that the emergent property allows the whole to act *as* a whole and directly influence future events.

Lastly, I would like to point out that many accounts of emergence make reference to the 'irreducibility' of emergent properties, and it is important to note that they usually come in varying degrees of ontological strength. Recall that we identified two types of reduction: type-reduction and token-reduction. As it turns out, O'Connor's emergent properties cannot be reduced in either way, thus they are ontologically irreducible and

they have their own genuine ontologically robust existence. O'Connor's is therefore quite obviously a stronger version of the 'irreducibility' claim.

O'Connor's justification for this seems to be as follows: It seems reasonable to believe that a macro-property may be at least token-reducible, unless it has added something new to a system (like a novel causal power). For, there really is no reason to believe that such a macro-property has its own independent existence until such an addition is made. Because emergent properties are non-structural and because we do need to suppose they exist in order to fully explain the behaviour of the complex systems which instantiate them, they do seem to have some sort of independent existence and thus seem not to be token-reducible. For if we could identify token-instances of emergent properties with lower-level properties, their causal powers would then have to belong to those lower-level properties as well but, if that were the case, the emergent property could not have been simple and thus emergent in the first place. Further, since token-reduction is the weaker of the two notions, it follows that emergent properties could not be type-reduced either. So emergent properties, in O'Connor's sense, have their own independent ontological existence.

In summary, we have learned that emergent properties are diachronically generated by natural physical causal processes, that they are qualitatively novel, simple, macro-level properties of whole systems, and that they allow those systems to act *as* wholes in virtue of their introduction of novel, fundamental, downward causal powers to those systems. We have also seen that this characterization of emergent properties entails that such properties are 'ontologically irreducible', fundamentally novel features of the world. Thus, O'Connor's emergent properties are emergent in a very robust sense.

CHAPTER 4: A COMPARISON OF ESFELD'S HOLISM AND O'CONNOR'S EMERGENCE

We are now in a position to compare Esfeld's and O'Connor's accounts and to answer the question of whether holistic properties can also be emergent.

As noted, accounts of both holism and emergence traditionally aspire to describe wholes as 'more than the sum of their parts' however, there are obviously many differences in the ways our two philosophers approach this task. And so one initial difference between these two accounts is that Esfeld considers his account of holism to be 'ontologically conservative', because holistic properties may still be realized by the properties of lower-level physical parts, whereas O'Connor's account is much more liberal and describes emergent properties as ontologically novel additions to the world. Notice, however, that although Esfeld goes to great lengths to argue that his account does not entail anything more than physicalism, he never commits to mere physicalism himself. It is therefore still possible, despite these differences, that Esfeld's account is consistent with O'Connor's stronger account of emergence. With that in mind, it remains a real question whether Esfeld's holism is compatible with O'Connor's emergence.

Another important, though not immediately visible distinction between these two accounts is that each is based on different concerns about the properties they propose. Whereas O'Connor's account of emergent properties focuses heavily on the nature of the property itself – its simplicity, its novel causal powers, and so on – Esfeld's account of holistic properties focuses more on the conditions necessary for the existence of that

property – the required generic ontological dependence among a system's parts – and he makes barely any mention of the nature of holistic properties which do come into existence. So membership in these categories of properties, holistic or emergent, is determined by focusing on different aspects of the property itself. Thus, at least initially, is seems plausible that a given property could require the holistic dependence between parts and could also have the nature of an emergent property. So this difference in the focus of these two accounts again does not remove the possibility that holistic properties can also be emergent. To highlight this point, and to assist us with our further comparisons, let us now review the definitions presented for each type of property:

A property is emergent if and only if:

a) The property is a "qualitatively new, macro-level feature" of the world;
b) The property is a "causal consequence of the object's exhibiting some general type of complex configuration";
c) The property is simple or non-structural; and
d) The property has a novel downward causal influence (on the system from which it emerged).

A property is holistic if and only if:

a) The property is determinable, qualitative, and non-disjunctive;
b) The property is a member of the 'constituenthood' family of properties (which, when instantiated, makes a part a constituent part of a certain kind of system); and
c) To instantiate the property, a system's parts are ontologically dependent in a generic way on there actually being other parts together with which they are appropriately arranged into that certain kind of system.

We can now rephrase our question: Let us ask whether there is anything inconsistent about there being a property a) which belongs to the family of properties which makes something a constituent of a system of a certain kind, and b) which is relational in the sense that its instantiation requires that the parts of a system are ontologically dependent in a generic way on their arrangement among other parts within

the system, and which is also c) non-structural, d) qualitatively novel, e) causally generated by the system's complex configuration, and f) which introduces a novel downward causal influence into the system.

As Esfeld's account of holism seems to focus primarily on the conditions necessary for the existence of holistic properties, let us move on to see whether there are any fundamental differences between his account and O'Connor's 'causal consequence' condition for the generation of emergent properties.

As we learned in chapter 2, because a holistic property is a special sort of relational property, it ontologically depends, in a generic way, on there being parts which come together to create a certain kind of system. In other words, a holistic property necessitates the existence of other parts and properties for its own existence. Knowing that, however, does not fully inform us of the *process* by which these properties are generated. To discover that information one has to piece together later elements of Esfeld's discussion of holistic properties, and only then can one come to see that Esfeld intends holistic properties to be 'globally supervenient' upon more basic properties. For, in the later chapters of his book, Esfeld argues that his primary examples of holistic systems, quantum holism and holism in philosophy of mind, both entail global supervenience, and thus that both allow for a form of direct scientific realism. He writes,

> when it comes to supervenience claims, both quantum holism and holism in the philosophy of mind have a common consequence: they clash with local supervenience claims, but fit into global supervenience. Thus, in the last resort, i.e., at the microphysical level, science is only compatible with global supervenience. This common consequence of quantum holism and holism in philosophy of mind shows that holism in philosophy of mind fits into a view of the world that bases itself on scientific realism.
>
> (p. 314.)

Whether or not this description is meant to be true of all holistic properties, or merely this specific subset of them, it does provide us with a generation story for Esfeld's main examples of holistic properties which we can now compare to the generation story in O'Connor's account.

As Esfeld did not include global supervenience as a component of his general account holism, it was not mentioned in the chapter outlining his position. However, now that we are trying to compare his account to O'Connor's, we should take a moment to discuss this relation as he defines it. Thus, Esfeld describes global supervenience as follows:

> Global supervenience is a thesis of covariation in the following sense: two possible worlds which differ with respect to the mental including the intentional differ also with respect to the physical. Thus, if one varies the mental, one has to vary the physical as well. The converse is not the case: there are possible worlds that differ with respect to the physical without differing with respect to the mental.
>
> (p. 158.)

It is apparent that this definition does seem to fit with Kim's (1990) account of global covariance which states that "worlds that are indiscernible in respect of subvenient properties are indiscernible in respect of supervenient properties" (p. 22). Recall that this is a fairly weak version of covariance which entails that holistic properties will reliably covary with a set of global base properties. For example, Esfeld mentions that the meaning of a belief is not solely determined by the physical brain states by which it may be realized, but instead one must identify the environmental and the social factors which

all help to ground meaningful beliefs if one is to identify its determinate meaning, and he argues similarly for quantum holistic properties as well. [34]

Note that Esfeld's appeal to supervenience also entails that holistic properties are synchronically determined by their global base conditions, and thus that at the very same moment at which the base conditions are appropriate, a supervenient property will occur. Again this is apparent in Esfeld's account. For example, Esfeld argues that a system of beliefs is not gradually acquired, at least not initially, because an individual belief would not be able to play an inferential role in isolation and thus would have no meaning. Instead, Esfeld argues that at the initial stages of the formation of a system of beliefs, a person must have at least a "representative sample" of other meaningful beliefs and thus a "rudimentary" system of beliefs which provide the inferential role of any one particular belief (p. 59). Again, if that were not the case, no belief would yet have any meaning. So we can see that Esfeld intends there to be no difference in time between the presence of the base conditions and the acquisition of a holistic property. We are now ready to review O'Connor's account of emergent property generation and compare it to the story provided by Esfeld of the generation of holistic properties.

Recall that O'Connor describes an emergent property as being the effect of a natural physical causal process. On his account, some physical properties have, among their basic causal powers, a 'tendency' to generate emergent properties. And although these physical properties are always acting to bring the emergent properties about, their powers are only effective when enough of such properties come together in a sufficiently complex system and can 'jointly achieve' their effect of generating an emergent property.

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[34] For further discussion see Esfeld (2001), p. 314, where he discusses the supervenience bases for both semantic and quantum holism.

Once generated, the emergent property of the system is then indirectly existentially dependent on the parts of the system only insofar as the whole system is dependent on the continued relation of the parts. Thus, the emergent properties of a system do not supervene on the lower-level properties or parts of a system, but are instead causally generated by and indirectly dependent on these components.

We can immediately see a difference between these two generation accounts – whereas Esfeld relies on supervenience, O'Connor does not. However, before we discuss this difference, I would like to highlight that there also seems to be an interesting similarity between the two accounts. At one point, O'Connor mentions that an emergent property is not solely determined by the physical properties of its system. Instead, he states that, despite consistency in the base conditions of a system, a "suitably fortuitous" change in the environmental influence on the system could result in the generation of a different emergent property (2000a, p. 11). Notice that this claim mirrors Esfeld's description of the global base of holistic properties. For Esfeld also argues that not only do the physical properties of the system play a role in determining the instantiation of a particular holistic property, but, at least in the case of the meaning of beliefs, the environment and the social community will also play a determinative role. Therefore, the influence of the global conditions seems to be similar in each account.

Despite that similarity, however, the rest of O'Connor's account seems to be incompatible with Esfeld's story of global supervenience. First and foremost, when O'Connor rejects the covariance principle, which generally states there can be 'no higher-level difference without a base difference', he effectively rejects the basis of Esfeld's account of the generation of holistic properties. Recall O'Connor rejects this by arguing that if emergent properties are causally generated, and if causation turns out to be

probabilistic, then, because his account is based on causation rather than supervenience, different emergent properties *could* result from the same physical base, regardless of how globally that base was described. In essence this means that there *could* be a higher-level property difference without a base-level property difference, and this directly refutes the covariance principle and thus puts O'Connor's account in direct conflict with Esfeld's account of holistic property generation.

A slightly more subtle difference between the two accounts lies in the temporal sequences of property generation in each account. Whereas Esfeld relies on a synchronic relation to account for the generation of holistic properties, O'Connor highlights the fact that emergent properties are generated at a time later than the initial existence of their base-level conditions. Since no one property can be generated in both ways, these two accounts are therefore importantly different and cannot both describe any single property.

As we have now seen, there is a substantial difference between Esfeld's holistic properties and O'Connor's emergent properties in regards to the way in which they are generated. Although both types of properties must inhere in sufficiently complex systems, holistic properties are supervenient upon base-level properties and thus they covary with those properties and are generated synchronically once the base properties exist. On the other hand, emergent properties are the result of a diachronic physical causal process and they need not reliably covary with their base conditions at all, at least not in the same sense. If both philosophers maintain allegiance to their particular generation stories, then it is apparent that there is no way to reconcile these two accounts. Therefore, since each type of property has a different relationship with the lower-level components of its system, we have to conclude that holistic properties cannot also be emergent, and emergent properties cannot also be holistic.

In light of this conclusion, I should note that O'Connor has not consistently denied that emergent properties supervene on physical ones. As previously mentioned, in O'Connor (1994) he did claim that emergent properties supervene on physical properties and even as late as O'Connor (2000b) he mentions that he will leave the question open as to whether emergent properties supervene on physical ones (p. 112). However, because of his detailed attempts to describe the 'natural causal process' by which emergents may be generated, and because avoiding supervenience allows him to circumvent Kim's (1999) objections to downward causation, I believe that O'Connor has ultimately rejected supervenience. That being said, if O'Connor were to return to an account involving this relation, then the generation stories of holistic and emergent properties would no longer be incompatible in this respect. Thus, perhaps their differences as to property generation should not play a large role in our overall evaluation of the compatibility of these two accounts.

With that in mind, another interesting question we can ask, despite the difference in their generation, is whether Esfeld's holistic properties can have the same sort of nature as O'Connor's emergent properties. This amounts to asking the following questions: 1) Can holistic properties be qualitatively new, macro-level features? 2) Can holistic properties be non-structural or simple? 3) Can holistic properties bring with them novel, downward causal influences? To extend our comparison, let us now investigate each of these questions in turn, in hopes of further identifying the relationships between these two kinds of properties.

Recall that emergent properties are to be 'qualitatively novel, macro-level features' of the world. First of all, this means that emergent properties are to be qualitatively distinct from any lower-level property. For example, O'Connor points out

that mental properties are qualitatively novel because they have 'subjective' natures that no lower-level physical properties seem to have. Secondly, emergent properties are 'macro-level' features because they are instantiated by higher-level systems and, following Wimsatt's (1976) description of levels, this entails that the property itself also belongs to that higher-level. Thus it is in this sense that emergent properties are qualitatively novel macro-level features of their systems. Now let us investigate whether holistic properties can be similarly described.

Although Esfeld does not require this of his holistic properties, there seems to be nothing conceptually inconsistent with both bottom-up and top-down holistic properties' being qualitative novel; the second criterion, however, seems to be a bit more discerning. Top-down holistic properties, like emergent properties, are instantiated by the whole system, so they do seem to exist on that higher-level because they are properties of the whole. Thus, assuming they can be qualitatively novel, top-down holistic properties can also be describes as qualitatively novel macro-level features of a system. The same does not seem to be the case for bottom-up holistic properties, for although it is possible that bottom-up holistic properties can have qualitatively novel natures, because they are only instantiated by parts of the system it seems that they do not also exist on the higher-level. Thus, bottom-up holistic properties are importantly distinct from emergent properties because they are not also macro-level features of their systems.

We can therefore conclude that, of the two types of holistic properties, only top-down holistic properties can be qualitatively novel macro-level features of their systems in a way similar to emergent properties.

The next question is whether holistic properties can be considered non-structural and in order to understand this question fully, we must review some relevant definitions from O'Connor's and Esfeld's theories:

> O'Connor's Definition of Structural Property:
> "A property, S, is structural if and only if proper parts of particulars having S have some property or properties not identical with S, and this state of affairs is constitutive of the state of affairs of the particular's having S." (2000b, p. 109)
> For example, the mass of a book is a structural property.

> Esfeld's Definition of Arrangement Property:
> Arrangement properties are "those relational properties in which the arrangement of other things consists" (p. 13). Specifically, they are properties whose description can be reduced "to a description of non-relational properties and the description of a suitable arrangement" (p. 19).
> For example, functional properties, such as 'being a blood pump' or 'being a thing that controls traffic' are arrangement properties.

> Esfeld's Definition of a Holistically Relational Property:
> A property is holistically relational, "if and only if it satisfies the following two conditions: 1) Instead of being an arrangement property, it belongs to the family of properties that makes something a constituent of [a system of a certain kind] provided that there is a suitable arrangement. 2) Nothing can have this property unless there actually are other things together with which this thing is arranged in such a way that there is [a system of a certain kind]" (p. 16).
> For example, the meaning of a belief (its inferential role) is a holistically relational property.

Recall that emergent properties cannot be structural, and holistic properties cannot be arrangement properties but must instead be relational in the sense outlined above. So, in order to find out if holistic properties can have natures similar to those of emergent properties, we must ask whether or not they are structural, and specifically whether or not there is anything inconsistent about a holistically relational property's being non-structural. Let us start then, with a general analysis of the relationships between these concepts.

It seems that arrangement properties must be structural, because they are constituted by the other properties of the parts and an arrangement of those parts. On the other hand, it is not clear that structural properties must also be arrangement properties, for they could be constituted by other properties but could have nothing to do with the arrangement of the system's parts. These two definitions are therefore not mutually exclusive. As for non-structural properties, because they are not constituted by and not token-reducible to any lower-level properties, they seem to be distinct from arrangement properties which are reducible to and constituted by properties at the lower level.

Now there is one further, slightly more complicated comparison to make concerning the relation between holistically relational properties and non-structural properties, and it is not immediately clear whether these two property descriptions are compatible. On the one hand, the fact that a property is holistically relational, i.e., that it necessitates the existence of other parts and properties which come together to form a certain system, surely sounds like there is some sense in which structure is involved. However, O'Connor says a property is only structural if it is constituted by the state of affairs involving the part's having other properties not identical with the property in question. This means that if the object which has a holistically relational property has other properties, not identical with that holistically relational property, and if that state of affairs (its having those other properties) constitutes the object's having the holistically relational property, then the holistically relational property is structural. This scenario however, does not seem to be true of Esfeld's holistic properties. For example, consider the meaning of a belief. It seems clear that there are no other properties of a belief that 'constitute' its meaning, for its meaning just is its inferential role, and that role just is the belief's relation to other beliefs. Thus the meaning of a belief in fact seems to be non-

structural. We can now see that a holistically relational property's dependence on the lower-level does not seem to determine its degree of simplicity. So although holistically relational properties necessitate a certain structure of the components of their system, the properties themselves are not necessarily structural and they can, therefore, be considered simple just like emergent properties.

Another factor which affects the simplicity of both bottom-up and top-down holistic properties is the possibility that they may be realized by lower-level physical properties. Since Esfeld allows that the meaning of a belief may be realized by the "physical states of the person in question in relation to her environment" (p. 314), it is possible that the meaning of the belief actually is just a series of neuron firings, for example. If that is the case, it seems that such a property would turn out to be structural after all. For, in such a case, the complex neuronal firing pattern may be actually 'constituted by' the properties of individual neurons, and thus this property could not be considered emergent.

To his credit, Esfeld does make a point of saying that holistic properties, "cannot be taken into account by a description of the properties which the things that are the constituents of [a system] can have in isolation" (Esfeld, p. 22). Thus he seems to believe that holistic properties, although physically realizable, cannot be considered 'merely' atomic physical properties themselves. When combined with Wimsatt's (1976) description of the reality of higher-level properties, it therefore may be fair to say that holistic properties do exist in some robust sense, regardless of the fact that they can be physically realized. However, I feel that this result would still not satisfy O'Connor. Instead I believe he would argue that if holistic properties are realized by physical ones then, as Kim (1995) argues, they can have no causal powers beyond those of their

realizers and thus their causal powers must be present in that physical lower-level. Should that be the case, then the holistic properties turn out to have been 'constituted by' those properties at the lower-level and thus could not have been emergent.

We can therefore conclude that the simplicity of a holistic property is not influenced by its dependence on the lower-level, but would be threatened if the property was realized by the properties at a lower-level. Therefore, as long as holistic properties are not physically realized, they can be non-structural and thus meet this criterion of O'Connor's definition of emergence.

Lastly, and most importantly, we come to the question of causal influence. One of the main criteria of emergent properties is that they provide their system with novel downward causal powers. As discussed, it is this part of their nature which ensures that emergent properties are ontologically irreducible, and therefore it is this part which makes O'Connor's account so robust. While Esfeld is careful to identify that his account is not committed to any such powers (in fact he explicitly sates that "holism is not committed to anything like downward causation" (p. 21)), he does not provide any further information about the causal influence of holistic properties. So, although we know that the introduction of holistic properties need not entail the introduction of novel downward causal powers, we can still ask whether a holistic property *could* have such powers, and thus whether it can meet this most important criterion of emergence.

In the previous chapter we learned that the two key elements of an emergent property's causal powers are that they allow for new causal possibilities in the world and that they allow the whole to act *as* a whole, instead of merely as a collection of individual constituent parts. This means that a system with an emergent property can be involved in future causal chains which are different than they would have been had the emergent

property not come into existence, and that the whole system has powers of its own, instead of merely indirectly having powers that are 'constituted by' the powers of its lower-level parts. So let us finally investigate whether Esfeld's holistic properties can provide for a similar causal influence.

First of all, we should note again that no structural macro-property could bring with it novel causal powers because any powers it has would belong to the properties of which it is constituted. The same can be said of any property that is physically realized. Thus, as we've seen, if holistic properties are physically realized, they could not introduce novel causal powers into the system. Aside from that, however, there seems to be nothing conceptually inconsistent with a holistic property's having novel causal powers. Thus both top-down and bottom-up holistic properties could conceivably introduce novel causal powers into a system. However, there is now the separate question of whether their novel causal powers could allow for a *downward* causal influence.

Recall that the influence of emergent properties is 'downward' because the whole system has a power which exists at the system's higher-level and, because the whole is composed of its parts, any action it takes will inevitably involve those parts. So any action of the whole which stems from powers that exist on the whole's higher-level will influence the whole's lower-level parts and it is in this sense that it has a *downward* causal influence. Let us now consider whether bottom-up holistic properties can provide a similar downward causal influence.

We can immediately recognize that, because it is the parts of the system which instantiate bottom-up holistic properties, and not the system itself, the addition of such properties to a system does not allow for a downward causal influence. Because bottom-up holistic properties, and thus their causal powers, exist on the lower-level of the parts,

such powers do not seem to enable the whole system to act as a whole in the right sense. Therefore, although they may introduce novel causal powers into a system, bottom-up holistic properties cannot provide the system with a downward causal influence and thus cannot also be emergent.

On the other hand, top-down holistic properties are importantly similar to emergent properties as concerns their causal influence. Because these properties also belong to whole systems, their causal influence can be downward in the emergent sense. Thus, assuming their causal influence can be novel, it seems that such properties can also provide their system with its own power and thus the ability to act *as* a whole in a way similar to properties that are emergent. So, unlike the other variety, top-down holistic properties could be causally similar to emergents.

The results of this comparison are quite interesting to say the least. Not only have we learned that it is possible to compare holistic and emergent properties, we have also learned that the distinction between the two types is not as severe as one may have thought. Although it seems that bottom-up holistic properties are not the right sort of properties to be emergent, top-down holistic properties are surprisingly compatible with such a description. Because they also belong to wholes, top-down holistic properties can be considered macro-level features that could potentially introduce downward causal powers into a system. As long as they are not realized by lower-level properties, and assuming that they can be qualitatively novel and can bring with them novel causal powers, top-down holistic properties could thus be emergent. As noted, however, any such conclusion is conditional upon the compatibility of the generation stories of each account and, as we have seen, these accounts are not compatible as they currently stand. We must therefore finally conclude that no property can be both holistic and emergent.

CHAPTER 5: CONCLUSION

In this project I have found that although Esfeld's account of holism and O'Connor's account of emergence each focus on different aspects of their proposed properties, it is a worthwhile question to ask whether the descriptions of the properties from each account are compatible, and thus whether holistic properties can also be emergent.

In answering this question, I first realized that the preferred property generation stories of each philosopher are not compatible. Whereas holistic properties supervene upon properties of a lower-level, emergent properties are diachronically caused by such properties and thus are not supervenient. Since each account posits a different relationship between its properties and those at the lower-level, the two accounts cannot describe the same property. However, I did note that O'Connor's generation story may be more flexible than presented and if that is the case, the two accounts may turn out to in fact be compatible in this respect. So I decided to consider my conclusions as conditional upon the compatibility of this part of each author's account.

Next, when considering that emergent properties must be 'qualitatively novel macro-level features' of a system, I found that only top-down holistic properties could be similarly described. Although both top-down and bottom-up holistic properties could be qualitatively novel, only top-down holistic properties could be considered macro-level features in the same sense as emergent properties. So, as regards this requirement, I concluded that only top-down holistic properties are compatible with emergence.

I then found that although a holistically relational property can be non-structural, if it is physically realized it must be constituted by other physical properties and thus can no longer be simple in the required sense. Thus, I concluded that as long as they are not physically realized, both types of holistic properties can be non-structural in the emergent sense.

Lastly, I found that only top-down holistic properties have the potential to bring about novel *downward* causal powers in the same way that emergent properties do. This is because bottom-up holistic properties are not instantiated by the whole itself and thus they do not allow the whole to act as a whole and influence its lower-level parts. So, as regards this criterion, again only top-down holistic properties can also be emergent.

An interesting point arises once we realize this potential similarity of causal influence between top-down holistic properties and emergent properties. Since holistic properties are supervenient, and since top-down holistic properties may potentially have downward causal powers, it becomes apparent that top-down holistic properties could fall victim to Kim's (1999) criticisms against the coherence of emergent causation. As no one had previously investigated these similarities and as holism is often considered "parsimonious in its ontological commitments" (Esfeld (2001), p. 164) no one seems to have suspected that the problems of downward causation would play any role in such accounts. It would be an interesting, yet separate project to further investigate how Esfeld would respond to these objections, although I suspect that the objections could be defeated. In any case, these concerns would have to be addressed before such an account of the causal powers of holistic properties could be considered coherent.

In summary, top-down holistic properties seem relevantly similar to emergent properties in most respects, whereas bottom-up holistic properties cannot be macro-

properties, cannot introduce downward causal powers, and therefore cannot also be emergent. However, because of the inconsistency between the stories of holistic and emergent property generation, not even top-down holistic properties can be unconditionally considered emergent at this point. Thus, I conclude that according to the current versions of Esfeld's account of holism and O'Connor's account of emergence, no property can be both holistic and emergent.

Thus concludes my investigation of holistic and emergent properties and I will leave the larger question of whether these conclusions apply to other accounts of emergence and holism for another occasion. I will say, however, that it becomes clear in the end that the important similarities between any version of holism and emergence will lay in the significance of the properties such accounts will introduce. And as we have seen in the small piece of the puzzle that we have examined here, because of the different natures of each of the three types of properties we have discussed, we have in fact identified that there are at least three different ways for a whole to be 'more than the sum of its parts'.

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