Global Supervenience, Coincident Entities and Anti-Individualism

ORON SHAGRIR

Theodore Sider distinguishes two notions of global supervenience: strong global supervenience and weak global supervenience. He then discusses some applications to general metaphysical questions. Most interestingly, Sider employs the weak notion in order to undermine a familiar argument against coincident distinct entities. In what follows, I reexamine the two notions and distinguish them from a third, intermediate, notion ("intermediate global supervenience"). I argue that (a) weak global supervenience is not an adequate notion of dependence; (b) weak global supervenience does not capture certain assumptions about coincidence relations; (c) these assumptions are better accommodated by the stronger notion of intermediate global supervenience; (d) intermediate global supervenience, however, may not be an adequate notion of dependence; and (e) strong global supervenience is an adequate notion of dependence. It also fits in with anti-individualism about the mental. It does not, however, serve to rebut arguments against coincident entities.

Global supervenience is of much interest to anti-individualists. Global supervenience, it is thought, can accommodate the idea that an individual's mental properties do not depend entirely on his or her 'local' physical structure, but also on the physical environment.[1] Theodore Sider (1999) argues that a version of global supervenience can also accommodate the idea that there are coincident distinct entities, for example, entities that do not differ in any of their momentary properties and relations, but do differ in their modal properties. Specifically, Sider distinguishes two notions of global supervenience – strong global supervenience and weak global supervenience – and contends that the weak notion can be used to rebut an argument against coincident entities, namely, the argument that coincident entities violate the requirement that the modal be grounded in the non-modal. Sider demonstrates that the requirement need not be violated if "grounded" is understood in terms of weak global supervenience.

My aim in this paper is to assess whether notions of global supervenience can indeed establish claims about the numerical coincidence of entities and about anti-

individualism. In section 1, I discuss weak global supervenience, arguing that it is doubtful that weak global supervenience is an adequate notion of dependence, and that weak global supervenience does not capture central assumptions about coincident entities. In section 2, I introduce another kind of global supervenience, intermediate between weak and global supervenience, to which I give the name "intermediate global supervenience". This notion is of interest for two reasons. First, like weak global supervenience, intermediate global supervenience is consistent with coincident entities. In fact, it better accommodates central assumptions about coincident entities than does weak global supervenience. And second, intermediate global supervenience is more likely to count, intuitively, as an adequate notion of dependence. In particular, it is not subject to objections that have been raised regarding weak global supervenience. Despite these virtues, even intermediate global supervenience may not count as an adequate notion of dependence. For that, we have to move up to strong global supervenience. In section 3, I argue that strong global supervenience is an adequate notion of dependence, and is consistent with anti-individualism with respect to the mental. However, strong global supervenience cannot rebut the arguments against coincident entities.

1. Weak global supervenience

Supervenience is a relation between sets A and B of properties and relations. Notions of supervenience come in local and global flavors.[2] The local notions concern the relations between the A-properties and B-properties of an object. They assert that A supervenes on B just in case any two objects that are B-indiscernible (i.e., have exactly the same B-properties) are also A-indiscernible. Local supervenience comes in

two sub-flavors, weak and strong. The weak version of local supervenience requires that B-indiscernible objects within a world be A-indiscernible, whereas the strong version requires that all B-indiscernible objects, even those from different possible worlds, be A-indiscernible.[3] The global versions of supervenience concern the relations between the distributions of A-properties and B-properties in worlds of objects. Three notions of global supervenience, weak, intermediate, and strong, are examined in the paper, beginning with weak global supervenience.

Weak global supervenience is defined as follows:

A <u>weakly globally supervenes</u> on B $=_{df}$ Any two possible worlds that are B-indiscernible are also A-indiscernible.

Two possible worlds, w_1 and w_2 are <u>A-indiscernible</u> $=_{df}$ There is an A-isomorphism from the domain of (i.e., set of objects existing at) w_1 onto the domain of w_2.

A function *f* is an <u>A-isomorphism</u> $=_{df}$ *f* is one-to-one, and for any *n*-place relation R in A and for any *n* objects in *f*'s domain, $R(a_1,\ldots a_n)$ iff $R(f(a_1),\ldots f(a_n))$.[4]

Scenarios (I) and (II) partially clarify the scope of weak global supervenience:

(I)	w_1	w_2
	Pa & Qa	Pb & ¬Qb

This scenario is inconsistent with the weak global supervenience of {Q} on {P}: w_1 and w_2 are {P}-indiscernible – the function from w_1 onto w_2 that maps a onto b is a {P}-isomorphism – but there is no {Q}-isomorphism from w_1 onto w_2.

Scenario (II), however, could be consistent with the weak global supervenience of {Q} on {P}:

(II)	w_1	w_2
	Pa & Qa	Pc & Qc
	Pb & ¬Qb	Pd & ¬Qd

The function that maps a to c and b to d is both a {P}-isomorphism and a {Q}-isomorphism from w_1 onto w_2.[5,6]

Now a familiar claim is that a statue and the lump of matter from which it is made are coincident yet numerically distinct entities, since they differ in their modal properties: the lump but not the statue can survive being flattened. In some cases, the statue and lump may differ in their histories, but in others they have the same histories and differ only in their modal properties.[7] Here, we focus on modal properties.

A pattern of arguments against construing the entities as coincident is that their modal properties cannot differ. The modal difference between the statue and the lump must be grounded in qualitative non-modal properties and relations, such as their subatomic structure. Following Sider, we will call these properties and relations BASE. Given that the statue and the lump – as coincident entities – share exactly the same BASE-properties and stand in the same BASE-relations at the time they coincide, what can ground the modal difference between the statue and the lump? After all, "should not two physical objects constructed in precisely the same way out of qualitatively identical parts have the same capacities for survival under similar conditions?" (Zimmerman 1995: 88). Assuming that modalities are grounded in BASE, and that the statue and lump have the same BASE-properties and stand in the same BASE-relations at the time they coincide, we must conclude that the statue and the lump cannot differ modally.[8]

Defenders of distinct coincident entities can challenge either the premise that coincident entities have the same BASE-properties and stand in the same BASE-relations, or the premise that modal properties are grounded in BASE. Sider, however, challenges the inference itself. He suggests that if 'grounded' is understood in terms of weak global supervenience, then the alleged conclusion does not necessarily follow: the statue and the lump can still differ in their modal properties. To appreciate this, assume that modal properties are grounded in BASE. Assume also that the statue

and the lump have the same BASE-properties and stand in the same BASE-relations but have different modal properties. This is roughly analogous to scenario (II), when we take {P} to be the BASE, {Q} the modal properties, one object to be the statue, and the other to be the lump. As (II) indicates, it is still possible that modal properties supervene on the BASE in the weak global sense. Weak global supervenience requires that BASE-indiscernible worlds be modal-indiscernible. It requires that in a BASE-indiscernible world, one object has the modal properties of the statue, and another the modal properties of the lump. But this requirement is certainly in accord with the entities' coincidence.[9]

Sider's reply to the argument against construing the entities as coincident is intriguing. But, as he himself observes, the rebuttal is successful only if weak global supervenience counts as an adequate notion of dependence. Since Sider concedes that modal properties are grounded in BASE, we must be sure that weak global supervenience relations constitute what we can consider to be grounding relations. We must ascertain whether the weak global supervenience of A on B establishes the dependence of A on B. I contend that weak global supervenience cannot establish this dependence. In addition, weak global supervenience does not capture certain assumptions about coincident entities.

Consider a third scenario:

	w_1	w_2
(III)	Pa & Qa	Pc & ¬Qc
	¬Pb & ¬Qb	¬Pd & Qd

This scenario could be consistent with the weak global supervenience of {Q} on {P}: w_1 and w_2 are {P}-indiscernible, as there is a {P}-isomorphism from w_1 onto w_2 that maps a onto c and b onto d. But w_1 and w_2 are also {Q}-indiscernible. The function that maps a onto d and b onto c is a {Q}-isomorphism from w_1 onto w_2.[10]

This example demonstrates that weak global supervenience does not require a conformity between B-properties and A-properties of *objects* across B-indiscernible worlds. It shows that the weak global supervenience of mental on physical properties is perfectly consistent with the existence of a world that is physically indiscernible from ours, but in which some trees are conscious and some people are not. Similarly, the weak global supervenience of modal properties on BASE is consistent with the existence of a world that is BASE-indiscernible from ours, in which there is an entity with the BASE of Mount Sinai and the modal properties of the lump, and another entity, with the BASE of the lump and the modal properties of Mount Sinai. Weak global supervenience does guarantee that some entities will have the modal properties of the statue and the lump in a BASE-indiscernible world. But it does not determine which entity in that world will have the modal properties of our world's statue.

The example not only highlights the weakness of weak global supervenience as a notion of dependence, but also indicates that weak global supervenience is weaker than the dependency relation that defenders of entities' coincidence have in mind. Defenders of coincidence hold that coincident entities could have different modal properties, but not just any modal properties. Even Sider assumes that the modal (and temporal) properties of the statue and the lump are instantiated, in other worlds, by the two objects that have the same BASE-properties and stand in the same BASE-relations as our world's statue and lump.[11] But, as we now see, weak global supervenience does not ensure this covariance. Weak global supervenience permits the existence of worlds in which the lump has the modal properties of Mount Sinai and vice versa. It will be interesting, therefore, to characterize a stronger notion of global supervenience that is assumed in Sider's counterargument. We will turn to this task in the following section.

Scenario (III), in sum, indicates that weak global supervenience relations would at best be very weak dependency relations, and further, that weak global supervenience is consistent with scenarios that even the defenders of the entities' coincidence might not approve. But all this does not undermine Sider's rebuttal of the argument against coincident entities. That weak global supervenience is consistent with odd scenarios like (III) only indicates that the alleged relations between modal properties and BASE are stronger than the weak global supervenience relations of (III). Thus if weak global supervenience relations are dependency relations, even if very weak ones, the stronger relations between modal and BASE are, a fortiori, dependency relations. To show that weak global supervenience cannot establish the dependency of modal properties on BASE, we must show that weak global supervenience is not an adequate notion of dependence. In the remainder of this section, I present an argument to that effect. I argue that weak global supervenience is not an adequate notion of dependence.

The argument starts with the observation that notions of supervenience merely express patterns of correlation. Or, as Kim (1998) puts it, they express patterns of covariance between A-properties and B-properties. Strong global supervenience expresses a covariance between A-properties and 'complex' B-properties.[12] Weak global supervenience expresses a covariance between distributions of A-properties in a world and disjunctions of distributions of B-properties.[13] That supervenience expresses covariation of properties needs no argument; it is a direct consequence of the definitions of supervenience. I am, therefore, using the term 'supervenience' in the sense of covariance.

The next step in the argument is the contention that supervenience relations, as patterns of property covariation, call for an explanation. Something must explain the

covariation, especially if it holds across-worlds. This claim is advanced by Kim (1998) in the context of mind-body supervenience: “What this shows is that the mere fact (assuming it is a fact) of mind-body supervenience leaves open the question of what *grounds* or *accounts* for it – that is, why the supervenience relation obtains between the mental and the physical” (p. 9). What demonstrates this, according to Kim, is the host of mutually exclusive classic solutions to the mind-body problem that are consistent with mind-body supervenience. Reductionism (type-identity), emergentism, (multiple) realization, some forms of epiphenomenalism, and perhaps even Cartesian interactionism are all committed, Kim argues, to mind-body supervenience. But, he continues, “if mind-body supervenience is a commitment of each of these conflicting approaches to the mind-body problem, it cannot itself be a position on this issue alongside these classic alternatives” (p. 9). Kim, in other words, suggests that the variety of conflicting accounts that are committed to mind-body supervenience implies that supervenience is not in itself an explanation of the mind-body problem, but a restatement of the problem that calls for an explanation. “We must conclude, then, that mind-body supervenience itself is not an *explanatory theory*; it merely states a pattern of property covariation between the mental and the physical, and points to the existence of a dependency relation between the two. Yet it is wholly silent on the nature of the dependence relation that might explain why the mental supervenes on the physical” (p. 10).

I find Kim’s argument very convincing. It successfully demonstrates that it is one thing to classify property covariation as a kind of supervenience, but quite another to explain that covariation. It is one thing to point out that the covariance between modal properties and BASE might be an instance of weak global supervenience. It is quite another to explain the weak global supervenience between modal and BASE.

Supervenience relations, even if of a strong sort, must themselves be explained in terms of the dependence they point to. If modal properties indeed supervene on BASE, then there must be a dependence relation that explains this supervenience.

This does not yet threaten the role played by weak global supervenience in Sider's defense of coincidence. Even if supervenience is not by itself a dependency relation, as Kim's conclusion might imply, it still "points to the existence of a dependency relation". For Sider, however, it does not really matter whether the weak global supervenience relations between modal and BASE are in themselves dependency relations, or whether they point to the existence of dependence. It only matters that modal properties are dependent on BASE. If the covariation between modal and BASE is a supervenience relation, as Sider argues, and if, as Kim suggests, a supervenience relation "points to the existence of a dependency relation", then the weak global supervenience of modal on BASE in fact points to the existence of dependence between modal properties and BASE. And this is precisely the conclusion of Sider's argument.

The third step in the argument is the observation that even if the supervenience of A on B "points to the existence of a dependency relation", there are different kinds of dependency relations it could point to. It might, for instance, point to the dependence of A on B. But it might also point to dependencies of both A and B on other properties, C-properties. I will use some familiar examples to explicate the distinction. An example of the first sort of relation is a case where events of type B, B-events, cause A-events. An example of the second is a case where there is a common cause: C-events cause both B-events and A-events.[14] Returning to mind-body supervenience, relations of the first sort include identity, emergence and realization; relations of the second sort are exemplified by parallelistic accounts that

ground mind-body supervenience in God's powers. The supervenience here points to dependencies of mental *and* physical properties on the way God created the world (pre-established harmony) or His intervention (occasionalism).[15] It might be the case, of course, that God established dependency relations of the first sort – identity, emergence, or realization. The difference between the two kinds of dependence lies in the way they account for supervenience. In the first case, the supervenience of A on B is explained in terms of the dependence of A on B. The explanation of mind-body supervenience in terms of identity, emergence and realization need not appeal to God's powers, even if God set these dependency relations in place. In the second case, the supervenience of A on B is explained in terms of the dependence of both A and B on C. Here, the appeal to C-properties – the appeal to God's powers in the pre-established harmony and occasionalist accounts of mind-body supervenience – is an essential part of the explanation.

This distinction is of great relevance to the debate over coincident entities. Sider, as pointed out earlier, infers the dependence of modal properties on BASE from the weak global supervenience of modal on BASE. But it now seems that we cannot infer the dependence of modal on BASE from the across-worlds weak global supervenience relations of modal properties on BASE. The weak global supervenience of modal properties on BASE could point to two kinds of dependence. It could point to the dependence of modal properties on BASE, in which case Sider's argument is established. But it could also point to the dependence of modal properties and BASE on some other C-properties, e.g., God's powers. But if the latter is the case, then it is less certain that the modal properties are also grounded in BASE. Until we are provided with an argument to that effect, we have to be open to the possibility that modal properties supervene on BASE, without being dependent on BASE.[16]

We will say of a given kind of supervenience (of A on B) that it constitutes an adequate notion of dependence iff all the supervenience relations of that kind could point to a dependence of A on B.[17] Conversely, a given sort of supervenience is *not* an adequate notion of dependence iff some supervenience relations of that sort cannot point to a dependence of A on B.[18] Thus, weak global supervenience is an adequate notion of dependence iff for any families of properties A and B, if A weakly globally supervenes on B, then it is possible for the A-properties to be dependent on and be determined by the B-properties. The last two steps of my argument are intended to demonstrate that weak global supervenience is not an adequate notion of dependence. I first note that some weak global supervenience relations are not object-covariations (in short: o-covariations), and then argue that A depends on B only if A o-covaries with B.

We will say that a set of properties A o-covaries with a set of properties B just in case for any A-property, A', and any possible object, x, which has A', A' is entailed by x's maximal B-property.[19] Intuitively, a maximal B-property of an object x is the complete world perspective of x in terms of B-properties. It can be described by an open formula that mentions every property of x and its worldmates, and every relation in x's world. For example, this would be the formula that expresses the maximal {P}-property of the object a in scenario (III):

x has property P; there is only one object, y, in the world other than x; y does not have P.

The term 'object-covariation' highlights the fact that A-properties and maximal B-properties are properties of *objects*. O-covariation, however, neither entails nor is entailed by local supervenience. On the one hand, strong global supervenience relations are o-covariations.[20] On the other hand, some weak local supervenience relations are not o-covariations.[21] As it turns out, there are also weak

global supervenience relations that are not o-covariations. To see this, consider (III), which is consistent with the weak global supervenience of {Q} on {P}. In this scenario, x's having the property Q is not entailed by x's maximal {P}-property: The objects a and c have the same maximal {P}-property, yet a has Q and c has ¬Q.

The last step of the argument is perhaps the most controversial. My contention, here, is that A is dependent on B only if A o-covaries with B. That is, the o-covariation of A with B is a necessary condition for the dependence of A on B. The basis for this claim is, roughly, as follows: If A is dependent on B, then the instantiation of any A-property is entailed by the instantiation of B-properties. But since A-properties are instantiated by *objects*, the instantiation of an A-property by an object must be entailed by the B-properties of this object and its worldmates, and this requirement amounts to the o-covariance of A with B. Let me explain. To say that a set A is dependent on a set B is to say that each member of A depends on the members of B. Given that the members of A and B are properties, the instantiation of each A-property should be dependent on the instantiation of B-properties. If the instantiation of an A-property is not dependent on the instantiation of B-properties, then, it seems, this A-property is also dependent on properties that are not B-properties.[22] Now, properties are instantiated by *objects*. Monadic properties are instantiated by single objects, and relations by tuples of objects. Thus, if A is dependent on B, then the instantiation of each A-property by any possible object is dependent on the instantiation of B-properties by objects. It is not required that the instantiation of an A-property by an object be dependent on the B-properties of that object. The instantiation of an A-property by an object could depend on the B-properties of its worldmates, perhaps all of them. All that is required is that the B-properties of the objects in a world, any world, determine the instantiation of the A-

properties to any given object in that world. It is thus required that any object's A-property is entailed by that object's maximal B-property. But since the maximal B-property of an object provides a complete specification of the instantiations of B-properties in that object's world, this requirement is equivalent to the o-covariance of A with B.

This line of reasoning helps explain why we hesitate to say that {Q} is dependent on {P} in scenario (III). The weak global supervenience of {Q} on {P} ensures that in worlds with exactly two objects, where one has P and the other does not, one object has Q and the other does not. Assume that w_3 contains exactly two objects x and y, and that Px and ¬Py. Does x have Q? If {Q} depends on {P}, we expect to have an answer for this question, since we have a complete specification of the instantiation of {P}-properties by x and its worldmates. But we cannot have an answer. Our x could have Q, as is the case in w_1. But x could also have ¬Q, as is the case in w_2. Weak global supervenience ensures that one object has Q and the other does not. But it does not determine which of the two objects in w_3 has Q and which has ¬Q. Thus, x's having Q is entailed neither by the {P}-properties of x, nor by x's maximal {P}-property. We do know that Qx if and only if ¬Qy, but this only shows that x's having Q is dependent on properties other than {P}.

This completes the argument against weak global supervenience as an adequate notion of dependence: (i) The supervenience of A on B expresses a property covariance between A and B. (ii) Supervenience does not, however, account for this covariation. It points, rather, to the existence of a dependency relation that accounts for the covariation. (iii) This dependency relation can be a dependence of A on B, but it can also be a dependence of some other sort. (v) A is dependent on B only if A o-covaries with B. But (iv) some weak global supervenience relations are not o-

covariance relations. Therefore, weak global supervenience is not an adequate notion of dependence. The argument, if sound, demonstrates that we cannot infer the dependence of modal properties on BASE from the weak global supervenience of modal properties on BASE. Modal properties can weakly globally supervene on BASE without being dependent on BASE. The argument, however, does not demonstrate that the suggested weak global supervenience relations of modal properties on BASE are not dependency relations. After all, some weak global supervenience relations might be, or point to, dependency relations. In the following section, I attempt to establish the stronger result that the suggested supervenience relations of modal properties on BASE are not, and cannot point to, a dependence of modal properties on BASE.

2. Intermediate global supervenience

In this section, I introduce and analyze a kind of global supervenience that falls somewhere between weak and strong supervenience. I call it intermediate global supervenience. Intermediate global supervenience is much like weak global supervenience, but has one additional constraint. Intermediate global supervenience is weak global supervenience augmented with the condition that if there is a B-isomorphism from w_1 onto w_2, then there is also a B-isomorphism from w_1 onto w_2 that is an A-isomorphism. The notion can be precisely defined as follows:

A <u>intermediately globally supervenes</u> on B $=_{df}$ for any two B-indiscernible worlds w_1 and w_2, there is some B-isomorphism *f* from the domain of w_1 onto the domain of w_2 that is also an A-isomorphism.

Intuitively, the new notion seems more likely to count as an adequate notion of dependence. In particular, intermediate global supervenience keeps together the B-

properties and the A-properties of objects in B-indiscernible worlds. It is inconsistent, for example, with scenario (III): {Q} does not intermediately globally supervene on {P}. The sole {P}-isomorphism from w_1 onto w_2 is that which maps a onto c and b onto d. But this {P}-isomorphism is not a {Q}-isomorphism. Similarly, intermediate global supervenience is inconsistent with a world that is BASE-indiscernible from ours, but in which one object has the BASE-properties of Mount Sinai but the modal properties of the statue, and another, the BASE-properties of the statue and the modal properties of Mount Sinai. [23]

Intermediate global supervenience can still fill the role of weak global supervenience in Sider's response to the anti-coincidence argument. Sider argues, it will be recalled, that weak global supervenience is consistent with the statue and the lump having different modal properties but having the same BASE-properties and standing in the same BASE-relations. All that is required is that in a world w, that is BASE-indiscernible from our own, there be one object with the same BASE and modal properties as the statue, and another with the same BASE and modal properties as the lump. But this requirement is fulfilled if there is a B-isomorphism from our world onto w that is also an A-isomorphism. Thus the requirement is surely consistent with intermediate global supervenience.[24]

That is the good news. The bad news is that it is still possible that even intermediate global supervenience is not an adequate notion of dependence. Jaegwon Kim articulates this concern in discussing the global supervenience of the mental on the physical. Kim points out that the global supervenience of the mental on the physical is consistent with a scenario in which two organisms of the same world have the same physical properties, but one is fully conscious and the other has no mental properties whatsoever:

> It is consistent with global supervenience for there to be two organisms in our actual world, which, though wholly indiscernible physically, are radically different in mental respects (say, your molecule-for-molecule duplicate is totally lacking in mentality). This is consistent with global supervenience because there might be no other possible world that is just like this one physically and yet differing in some mental respect (Kim 1989: 42).

This scenario, though inconsistent with our intuitions about the dependence of mental on physical properties, is arguably consistent with intermediate global supervenience. We may call scenarios like this 'local-twins' to indicate two objects, inhabiting the same world and having the same B-properties.

Paull and Sider (1992: 846-847) criticize Kim's local-twins example, arguing that it does not threaten global supervenience. Given that global supervenience is defined over all possible worlds, Paull and Sider consider a pair of physically indiscernible worlds, each containing an object in isolation.[25] In one world the object is a duplicate of (i.e., has exactly the same intrinsic properties as) the conscious organism, and in the other, it is a duplicate of the unconscious organism. If the physically indiscernible isolated duplicates differ mentally, then the local-twins example is inconsistent with mind-body global supervenience: the two worlds are physically indiscernible, but mentally discernible. But if the isolated duplicates do not differ mentally – say, both are unconscious – then "the supervening properties do depend on the base properties, albeit in a rather strange way" (p. 846). In this case, being conscious would be an extrinsic property, affected, perhaps, by physical properties in the organism's environment. Paull and Sider conclude that the local-twins example does not threaten global supervenience: the example is either inconsistent with global supervenience or consistent with the dependence of the mental on the physical.

But the analysis of the second case is incomplete as long as we construe global supervenience in terms of intermediate global supervenience. Assume that Kim's example is consistent with intermediate global supervenience. This might show that

being conscious is an extrinsic property. But it does not yet follow that being conscious is dependent on the physical. We must distinguish two different kinds of scenarios: local-twins$_1$ and local-twins$_2$. On local-twins$_1$ scenarios, the twins have the same intrinsic B-properties, but different maximal B-properties. The twins differ, for example, in their B-relations to their worldmates. In addition, the twins have different A-properties. On these scenarios, the intermediate global supervenience of A on B might point to a dependence of A on B, as the difference in the twins' A-properties can be attributed to the difference in their maximal B-properties. Thus, the analysis suggested by Paull and Sider is correct with regard to local-twins$_1$ scenarios. Given that the twins have different physical relations to their environments, their difference in mentality can be attributed to these different physical relations. In particular, being conscious, as an extrinsic property, can be said to depend on the organisms' physical properties and relations. In the next section, we will see that local-twins$_1$ scenarios are also consistent with strong global supervenience (to be defined below).

On local-twins$_2$ scenarios, the twins have not only the same intrinsic B-properties. They also have the same B-world-perspective in the sense of having the same maximal B-properties. In addition, they have different A-properties. On these scenarios, then, A does not o-covary with B: the twins have the same maximal B-properties, but different A-properties. Thus, if these local-twins$_2$ scenarios are consistent with the intermediate global supervenience of A on B, then intermediate global supervenience is not an adequate notion of dependence. A could intermediately globally supervene on B, though A *cannot* depend on B.

To see that local-twins$_2$ scenarios are consistent with intermediate global supervenience, consider scenario (II) once again. The scenario could be consistent with the intermediate global supervenience of {Q} on {P}: the function from w_1 onto

w_2 that maps a onto c and b onto d is both a {P}-isomorphism and a {Q}-isomorphism.[26] Scenario (II) is of the local-twins$_2$ variety: local twins a and b not only have the same intrinsic {P}-properties, but also the same maximal {P}-properties (i.e., x has P; there is exactly another object in the world, y; y has P). Still, a and b have different {Q}-properties: a has Q and b has ¬Q. Thus, even though {Q} intermediately globally supervenes on {P}, {Q} is not dependent on {P}. Intermediate global supervenience guarantees that in all worlds with just two objects, x and y, and in which both objects have P, one object has Q and the other ¬Q. But the within-world difference with respect to {Q} is not grounded in {P}. Objects a and b, though having different {Q}-properties, have the same {P}-properties, and, in fact, also the same maximal {P}-properties. Thus, the instantiation of Q by one object and not by the other is not determined by {P}. An object's having Q is dependent on properties other than {P}.

Returning to Kim, we can reconstruct his example as a local-twins$_2$ scenario. On this scenario, the conscious and unconscious organisms not only have the same intrinsic physical properties, but also the same maximal physical properties. The physical environments of the organisms, and their physical relations to these environments, are exactly the same. Thus, nothing in the physical environments of the organisms can account for the difference in mentality. On these scenarios, being conscious is extrinsic, without being dependent on physical properties and relations. In the next section, we will see that local-twins$_2$ scenarios are inconsistent with strong global supervenience. They are consistent, however, with intermediate global supervenience. It thus follows that intermediate global supervenience of the mental on the physical is, in fact, consistent with scenarios on which being conscious is not dependent on the physical.

Kim's local-twins example has a direct bearing on Sider's reply to the anti-coincidence argument. It is assumed in the reply, correctly, that intermediate global supervenience is consistent with scenarios in which two objects from the same world have the same B-properties but different A-properties. The reply, we saw, makes use of these scenarios, taking modal properties to be A, taking BASE to be B, and taking the statue and the lump as two objects. Though having different modal properties, the statue and the lump are local twins in the sense that they have the same BASE-properties and stand in the same BASE-relations. Do the statue and the lump only have the same intrinsic BASE, or also the same maximal BASE-properties? If the statue and the lump have different maximal BASE-properties, such as different BASE relations to their environments, as in the local-twins$_1$ scenarios, we do not need the notion of intermediate global supervenience. We can account for the dependence of modal on BASE in terms of strong global supervenience. But given that the statue and the lump have exactly the same maximal BASE-properties, as in the local-twin$_2$ scenarios, we find ourselves in a quandary: since these scenarios are inconsistent with the o-covariance of modal properties with BASE, every notion of supervenience that allows these scenarios is not an adequate notion of dependence. On the other, if we move up to a notion of supervenience that is inconsistent with local-twin$_2$ scenarios, we end up with a notion of supervenience that rules out coincident entities. We must conclude that the intermediate global supervenience of modal properties on BASE does not show that modal properties are dependent on BASE. If anything, the question of coincident entities helps reveal why intermediate and weak global supervenience are not adequate notions of dependence.

3. Strong global supervenience

Strong global supervenience can be defined as follows:

A strongly globally supervenes on B =$_{df}$ For any two worlds w_1 and w_2, any B-isomorphism from w_1's domain onto w_2's domain is also an A-isomorphism.[27]

As already pointed out, strong global supervenience is an adequate notion of dependence: all strong global supervenience relations are o-covariations. Thus, strong global supervenience is obviously stronger than intermediate global supervenience. In particular, local-twins$_2$ scenarios, which are consistent with intermediate global supervenience, are inconsistent with strong global supervenience. Take scenario (II). The function from w_1 onto w_1 that maps a onto b and b onto a is a {P}-isomorphism, but not a {Q}-isomorphism. Likewise, the function from our world onto itself that maps the statue onto the lump, the lump onto the statue, and any other object onto itself, is a BASE isomorphism, but not a modal isomorphism. Thus, given that coincident entities have the same maximal BASE-properties and different modal properties, and given that modal properties are grounded in BASE, strong global supervenience is inconsistent with the lump and the statue having different modal properties.

Strong global supervenience is consistent, however, with local-twins$_1$ scenarios. Let A = {Q} and B = {P, R, S}. The following scenario, (IV), is of the local-twins$_1$ kind:

(IV) w_1

Pa & Rac & Qa
Sc

Pb & Rbd & ¬Qb
¬Sd

Assuming that P is an intrinsic property, the objects a and b are local twins. They have exactly the same intrinsic B-properties – i.e., they both have P – but different A-properties. Still, the objects a and b are local-twins$_1$ since they have different maximal B-properties: a stands in a relation R to an object that has S, while b stands in a relation R to an object that has ¬S. Finally, A strongly globally supervenes on B if we define Q as follows:

$Qx =_{df} Px \ \& \ (\exists y)(Sy \ \& \ Rxy)$.

Take any B-isomorphism, *f*, between two B-indiscernible worlds, w_1 and w_2. The objects x in w_1 and *f*(x) in w_2 have exactly the same maximal B-properties. Since Q is defined solely in terms of B-properties, the distribution of Q in two B-indiscernible worlds will apply the same with respect to B-indiscernible objects. In particular, the objects x and *f*(x) would have the same A-properties. Thus *f* is also an A-isomorphism.[28]

It would be interesting to compare strong global supervenience (which entails that two objects that have exactly the same maximal B-properties also have the same A-properties) to strong *local* supervenience (which entails that two objects that have exactly the same B-properties also have the same A-properties). Let us distinguish two cases. In the first, the B-properties are monadic.[29] Paull and Sider (1992) prove, that in this case, global and local strong supervenience are not equivalent. Let B = {P,S} and Qx = Px & ∃ySy. On the following scenario, (V), a and b have the same B-properties but different {Q}-properties:

(V)

w_1	w_2
Pa & Qa	Pb & ¬Qb
Sc & ¬Qc	

Thus {Q} does not strongly locally supervene on B.[30] The scenario, however, does not rule out the strong global supervenience of {Q} on B. Though a and b have different

{Q} properties, they also have different maximal B-properties: a has the maximal B-property "x has P; there is exactly one more object in the world, y; y has S", while b has the maximal B-property "x has P; there is no object in the world other than x". Paull and Sider indeed prove that {Q} strongly globally supervenes on B.[31]

In the second case, the B-properties include relations. This case presents a difficulty for strong local supervenience. On the one hand, strong local supervenience compares pairs of single objects, but, on the other hand, relations are defined over tuples of objects. We could express relations in terms of properties of single objects, for instance in terms of maximal properties. The problem then would be that what is being measured is no longer the strong local supervenience of A on B, but rather the strong local supervenience of A on the set of the maximal B-properties.[32] Strong global supervenience does not have this problem: it measures the supervenience of A on B in terms of the relations between A-properties and maximal B-properties *of objects*. It is therefore much more natural to use strong global supervenience when the set B includes relations.

Anti-individualism with regard to the mental is the view that mental properties of an individual, such as thoughts, beliefs and desires, are essentially individuated by reference to features in the individual's environment. [33] The claim is often rephrased as a denial of local supervenience. Anti-individualists argue that mental properties do not strongly locally supervene on intrinsic physical properties. It is possible to have two individuals, say, one on Earth and the other on Twin-Earth, that have exactly the same intrinsic physical properties, but different mental properties. The individual on Earth believes that water is wet, whereas the duplicate on Twin-Earth believes that twater is wet. Anti-individualists with materialistic inclinations also maintain that mental properties are dependent on physical properties: they are dependent on the

individual's physical properties, and his or her relations to the environment. In particular, they argue that the two mentally discernible twins differ in their relations to the physical environment. It seems that such twins would be of the local-twins$_1$ variety: they have the same intrinsic physical properties, different maximal physical properties, and different mental properties.

For a long time, a search has been underway for a notion of supervenience that can accommodate the idea that mental properties are not dependent on intrinsic physical properties alone, but on physical properties and relations. Though notions of global supervenience can accommodate the local-twins$_1$ scenarios advanced by anti-individualists, they have been repeatedly deemed inadequate as notions of dependence.[34] As shown here, this criticism is justified when global supervenience is understood in terms of weak and intermediate global supervenience. Strong local supervenience, though an adequate notion of dependence, has been deemed incompatible with anti-individualism. If the physical base includes only intrinsic properties, the strong local supervenience of mental on the physical is inconsistent with anti-individualism.[35] And if the physical base also includes relations, then strong local supervenience does not have the resources to express these relations.

Strong global supervenience is the notion that anti-individualists have been looking for. On the one hand, strong global supervenience, like strong local supervenience, is an adequate notion of dependence. But, unlike the local notion, strong global supervenience elegantly captures the idea that mental properties supervene on physical properties and relations. In particular, the strong global supervenience of mental properties on physical properties and relations entails that two individuals with exactly the same physical maximal properties also have exactly the same mental properties. On the other hand, strong global supervenience, like the

weaker notions of global supervenience, can accommodate local-twins$_1$ scenarios. As such, the strong global supervenience of mental properties on physical properties and relations is consistent with twins having the same intrinsic physical properties, different physical relations with the environment, and different mental properties.[36]

Oron Shagrir
Department of Philosophy
The Hebrew University
Jerusalem, ISRAEL

Notes

[1] See Petrie (1987), Horgan (1993), Shagrir (1999), and Sider (1999).
[2] Throughout the paper I will often use the locution 'properties' to refer to both properties and relations. In specific examples, I use monadic predicates to signify properties attributed to single objects, either intrinsic or extrinsic (relational). N-place predicates signify n-place relations.
[3] See Horgan (1993) for formal definitions.
[4] The definitions are Sider's (1999: 915-916).
[5] Paull and Sider (1992) remind us that weak global supervenience is defined over all possible worlds. Thus (II) is consistent with weak global supervenience if it does not violate the requirement that *any* pair of possible worlds that are {P}-indiscernible are also {Q}-indiscernible. I discuss this scenario in greater detail in section 2, proving that, under one definition of Q, {Q} weakly globally supervenes on {P}.
[6] Scenarios (I) and (II) indicate that weak global supervenience and weak local supervenience are different kinds of supervenience. Scenario (I) is inconsistent with weak global supervenience, but may be consistent with weak local supervenience (since a and b do not inhabit the same world). Scenario (II) may be consistent with weak global supervenience, but is inconsistent with weak local supervenience (a and b in w_1 are {P}-indiscernible but {Q}-discernible). Weak local supervenience does not have the modal force of weak global supervenience, but has more local force.
[7] See, for example, Wiggins (1980: 30-31) and Sider (1999: 929 ff.).
[8] See also Heller (1990: 30-32) and Burke (1992).
[9] Sider (1999: 928-935).
[10] See Sider (1999: 918). To see that the relations can hold across all possible worlds, let us define Q as follows: $Qx =_{df} \exists yPy \ \& \ \exists z \ (x \neq z \ \& \ \neg Qz)$.
Claim: {Q} weakly globally supervenes on {P}.
Proof: It follows from the definition that Q is instantiated only in worlds with at least one P-object (object that has P) and one ¬Q-object. In any such world, all the other objects, if there are any, are Q-objects. Now, take any two {P}-indiscernible worlds, w_1 and w_2. It follows from the {P}-isomorphism that w_1 and w_2 have the same number of objects, and the same number of P-objects. If w_1 (and so w2) include no P-objects, or less than two objects, then there are no Q-objects in w_1 and in w_2, and w_1 and w_2 are {Q}-indiscernible. In all other cases, one of the objects in w_1 (and so in w_2) is a ¬Q-object, and the others, if there are any, Q-objects. Thus a one-to-one function from w_1 onto w_2 that maps the ¬Q-object of w_1 onto the ¬Q-object of w_2 is a {Q}-isomorphism. Thus w_1 and w_2 are {Q}-indiscernible.

Given that the definition of Q is circular, we may think of the definition, instead, as a criterion for attributing Q to objects, or as a mere description of the pertinent relations between {Q} and {P}.
[11] Sider 1999: 934-935.
[12] Sider (1999: 920-921, note 17) proves that the strong global supervenience of A on B entails the necessary coextension of A-properties and generalized B-properties.
[13] Sider (1999: 921-922) characterizes weak global supervenience relations in terms of a necessary equivalence between propositions that describe the distribution of A-properties (to all objects in a world) and propositions that describe distribution of B-properties in that world.
[14] In this scenario, the covariance is not coextension, as the causes and effects are different token events.
[15] In the classic accounts of pre-established harmony and occasionalism the covariance is no coextension as the mental tokens are not physical tokens. But here we can assume token identity. Mental events are physical events. The parallelism refers to properties, not to events.
[16] I believe that the opponents of coincident entities will argue that Sider cannot assume, without providing an argument, that the following two claims are true together: the claim that the range of possible worlds is a product of the divine decree mentioned by Sider, and the claim that we can infer dependencies from possible worlds. They will deny the latter claim is true, if the former is true, by pointing out that A and B can be dependent on C (as a matter of the relevant divine decree), without A being dependent on B. And they will deny that the former claim is true, if the latter is true, by pointing out that our intuitions about the dependence of modal properties on BASE show that the range of possible worlds was not established by the divine decree mentioned by Sider, but, perhaps, by a different decree.

[17] The 'could' reminds us that any supervenience relation could also point to dependencies other than A on B. Mind-body strong supervenience may, for instance, also point to a version of occasionalism.
[18] The 'some' reminds us that even the weakest notions of supervenience are consistent with very strong dependency relations. In particular, the weak global supervenience of A on B is consistent with A's being identical to B.
[19] The notion of a maximal B-property is Sider's. In addition, Sider shows that the definitions and the results that obtain for properties are also true of relations. I focus on properties to simplify the presentation.
[20] This result is proved in Sider (1999: 920-921, note 17). Strong local supervenience relations are also o-covariations, since an object's A-properties are entailed by that object's B-properties.
[21] That weak local supervenience does not entail o-covariance is illustrated by scenario (I). This scenario may be consistent with the weak local supervenience of {Q} on {P} (see note 5), but inconsistent with the o-covariance of {Q} with {P}: a and b have the same maximal {P}-property, but different {Q}-properties. Thus, a's having Q is not entailed by its maximal {P}-properties.
[22] Note that o-covariance does not entail that the A-properties are instantiated one by one. In particular, o-covariance is consistent with holism regarding the mental. Those who take a holistic approach to the mental insist that we cannot attribute to someone anything less than a comprehensive set of beliefs and desires. Those holists who also believe in mind-body supervenience maintain that any set of beliefs-desires attributed to someone is dependent on physical properties. On this sort of holism, then, someone having a maximal physical property, P*, determines her having a whole set of mental properties, not just a single mental property. But this requirement is consistent with o-covariance: someone having a mental property from this set is entailed by her having P*.
[23] I thus believe that intermediate global supervenience best captures the notion of global supervenience found in the literature. This conclusion is based on examples that appear to challenge the claim that global supervenience is a dependency relation. Scenario (III), with all its implications, has never before been adduced to challenge global supervenience. So it is unlikely philosophers have thought about global supervenience in terms of weak global supervenience. Since some versions of Kim's local twin story are inconsistent with strong global supervenience (see below), it is equally unlikely they have thought about global supervenience in terms of strong global supervenience. Intermediate global supervenience is inconsistent with scenario (III), and consistent with local twins. Hence, it is probably the notion of global supervenience philosophers have had in mind. I have not mentioned the wayward atom example, because I believe that Paull and Sider (1992) convincingly show that it does not constitute a counterexample to global supervenience being a dependency relation.
[24] More specifically, the requirement is that any object x in our world has a counterpart, x', in w, with the same BASE and modal properties as x. And this requirement amounts to the claim that BASE$\cup$modal properties weakly globally supervene on BASE. But as Sider pointed out to me (in a private communication), the weak global supervenience of A$\cup$B on B is equivalent to the intermediate global supervenience of A on B.
Proof (of the equivalence): Assume the weak global supervenience of A$\cup$B on B, and that w_1 and w_2 are B-indiscernible. It follows from the weak global supervenience of A$\cup$B on B that w_1 and w_2 are also A$\cup$B-indiscernible, namely, that there is an A$\cup$B-isomorphism from w_1's domain onto w_2's domain. It is a basic result of set theory that an A$\cup$B-isomorphism is both an A-isomorphism and a B-isomorphism. Thus, A intermediately globally supervenes on B.

In the other direction, assume that A intermediately globally supervenes on B, and assume that w_1 and w_2 are B-indiscernible. It follows from these assumptions that there is a B-isomorphism from w_1 onto w_2 that is also an A-isomorphism. It is a basic result of set theory that this isomorphism is an A$\cup$B-isomorphism. Thus A$\cup$B weakly globally supervenes on B.

At some point, Sider (1999: 934, note 45) considers the weak global supervenience of the union of modal and BASE on BASE. Sider thus has recourse to intermediate global supervenience, though he is apparently unaware of it.
[25] On the possibility of these worlds, see Paull and Sider (1992: 838-839). An object y exists in isolation in a world iff the world contains only: y, y's parts, and other objects whose existence is entailed by the existence of y and its parts.
[26] To see that the relations hold across worlds, let us define the property Q as follows:

$Qx =_{df} Px \ \& \ \exists y \ (y \neq x \ \& \ Py \ \& \ \neg Qy)$

Claim: {Q} intermediately globally supervenes on {P}
Proof: It follows from the definition of Q that (i) all Q-objects are also P-objects, (ii) that in a world with exactly one P-object, this object has $\neg$Q, and (iii) that in any worlds with at least two P-objects,

one P-object has ¬Q, and the others have Q. Now, take any two {P}-indiscernible worlds w_1 and w_2. Let n be the number of P-objects in each of the two worlds. If n≥2, then in each of the two worlds, one P-object has ¬Q, the other P-objects have Q, and all the ¬P-objects have ¬Q. Thus a one-to-one function from w_1 onto w_2 that maps the P-object which has ¬Q in w_1 onto the P-object that has ¬Q in w_2, and any of the other n-1 P-objects in w_1 onto any of the other n-1 P-objects in w_2, is both a {P}-isomorphism and a {Q}-isomorphism from w_1 onto w_2. If n<2, then all objects in both worlds have ¬Q. Thus the {P}-isomorphism from w_1 onto w_2 is, trivially, a {Q}-isomorphism.

[27] Sider attributes this definition to Phillip Bricker. An equivalent definition in terms of object sequences is provided by Sider (1999: 916-917).

[28] A rigorous proof for the claim that A strongly globally supervenes on B would parallel to that given by Paull and Sider (1992) for the strong global supervenience of A on B in scenario (V) below.

[29] I assume throughout the section that the A-properties are always monadic (either intrinsic or extrinsic).

[30] Paull and Sider (1992: 840-841).

[31] Paull and Sider (1992: 852-853). Two more results are worth mentioning (given that all members of B are monadic properties).

Claim: Strong local supervenience entail strong global supervenience.

Proof (outline): Assume that *f* is a B-isomorphism from w_1's domain onto w_2's domain. Thus any object x in w_1 has a counterpart x' in w_2 with exactly the same maximal B-properties. Since all the B-properties are monadic, x and x' must also have the same B-properties. From the strong local supervenience of A on B, it follows that x and x' must also have the same A-properties. Thus *f* is also an A-isomorphism.

Claim: The strong global supervenience of A on B is equivalent to the strong local supervenience of A on the set of maximal B-properties.

Proof (outline): Assume the strong global supervenience of A on B. Take any two possible objects x and x' with the same maximal B-properties. Since a maximal B-property provides a complete description of the B-properties in a world, there must be a B-isomorphism, *f*, from the domain of x's world onto the domain of x''s world, and *f*(x)=x'. It follows from strong global supervenience that *f* is also an A-isomorphism. Thus, x and x' have the same A-properties.

For the other direction, assume the strong local supervenience of A on the set of maximal B-properties. Take any two B-indiscernible worlds w_1 and w_2, and any B-isomorphism *f* from w_1 onto w_2. We should show that *f* is also an A-isomorphism from w_1 onto w_2. Take any A-property, A', and any object x with A'. It follows from the B-isomorphism that x and *f*(x) have exactly the same maximal B-properties. Also, it follows from strong local supervenience that x and *f*(x) have the same A-properties. It thus follows that *f*(x) has A'. Hence *f* is also an A-isomorphism.

[32] To appreciate the difficulty, consider again scenario (IV). The objects a and b are B-indiscernible in the sense that they have the same monadic B-properties P and ¬S, and they both stand in a relation R to some object. But they still differ in their B-world perspective. Their maximal B-properties are different: the object a stand in a relation R to an object, c, that has S, and the object b stands in a relation R to an object, d, that has ¬S. This example shows that in many cases (and, in particular, in the examples advanced by anti-individualists) we should measure the supervenience of A on B-properties and relations in terms of the supervenience of A on maximal B-properties.

[33] See, for example, Burge (1979).

[34] See Kim (1987, 1989).

[35] Note that the strong global supervenience of mental properties on intrinsic physical properties is also inconsistent with twins having the same intrinsic physical properties but different mental properties. The function from our world onto itself that maps the first twin onto the second, the second twin onto the first, and any other object onto itself, is a physical isomorphism but not a mental isomorphism.

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