Cryptobiosis and Composition (Presidential Prize Award Winner)

David Skowronski
Baylor University

1. The Special Composition Question, Organicism, and Cryptobiosis

The Special Composition Question (SCQ) asks: when do objects (the parts) compose another object (the whole)—what are the necessary and sufficient conditions for the *x*s to compose some *y*? In *Material Beings* (1990), Peter van Inwagen answers SCQ as follows:

> The *x*s compose *y* iff the activity of the *x*s constitutes a life.
> (van Inwagen, 1990, p. 82)

Though van Inwagen does not name his answer, call it Organicism. Van Inwagen notes that it is desirable for one's answer to SCQ to suggest and accommodate the persistence of such composites through time (van Inwagen, 1990, p. 142). This is generally an advantage of Organicism, as a composite's persistence is normally coextensive with its life. However, a life can be suspended or interrupted, say by freezing. Consider tardigrades—these impressively resilient creatures can survive extreme conditions such as desiccation and freezing by entering a state known as cryptobiosis, which is characterized by the temporary cessation of metabolic function. Cryptobiosis can be thought of as a state somewhere between life and death (Clegg, 2001, p. 615), or arguably as a kind of reversible death (Neuman, 2006, p. 260). Perhaps someday cryopreservation advancements will allow us to place any creature, ourselves included, into a cryptobiotic state. This raises a question for Organicism: supposing that a cryptobiotic organism is not alive, is it still a composite? Borrowing from van Inwagen, suppose a cat is alive at t_1, completely frozen at t_2, and later revived at t_3 (van Inwagen, 1990, p. 146). Is the cat alive while frozen? Given what Clegg and Neuman say about cryptobiosis, the answer is plausibly no, the cat is not alive while its biological processes are suspended. The issue here is that anyone who agrees that the frozen cat is not alive and is also partial to Organicism has to say that the cat-qua-composite ceases to exist at t_2 and comes back into existence at t_3 (if it is even then the same cat). This conflicts with the intuition that the same cat persists through all of t_1, t_2, and t_3. Suppose you were placed in suspended animation. It seems

plausible that you continue existing while in stasis, even if you are not technically alive.

Assuming cryptobiotic organisms are not alive and yet persist while suspended, some adjustment to Organicism is warranted. To accommodate such intuitions, van Inwagen proposes the following modification:

> The *x*s compose *y* iff the activity of the *x*s constitutes a life or the individual properties of the *x*s and their relations to one another are unchanging (at the level of activity at which the processes of life take place) and when the *x*s were last changing, their activity constituted a life. (van Inwagen, 1990, p. 148)

The latter disjunct is a mouthful, especially compared to the simplicity of Organicism. Van Inwagen suggests thinking of stasis as a special kind of activity and reading the modification as "results from," which results in:

> The *x*s compose *y* iff the activity of the *x*s constitutes or results from a life. (van Inwagen, 1990, p. 148)

Call this van Inwagen's Modification (VIM). VIM allows us to say that the *x*s that compose the cat at t_1 and t_3 also compose the cat at t_2, since the *x*s are unchanging at t_2 and their activity constituted the cat's life when they were last changing. This holds even if the cat is technically not alive at t_2. While VIM may initially seem to do the trick, it solves one problem by introducing another: VIM permits cases where one group of objects compose something while a duplicate group of objects do not compose anything. One such case will be presented, followed by alternatives to VIM—modifications to Organicism that allow for cryptobiotic composites without running into similar duplication problems. I settle on a dispositional variant.[1]

2. Frozen Copycats

Suppose a scientist has a highly advanced 3-D printer which she uses to print an exact duplicate of the cat frozen at t_2. Call the original frozen cat Anna and the frozen copycat Elsa. According to VIM, Elsa is merely a collection of particles, not a composite. This is because the activity of Elsa's *x*s did not constitute a life when they were last changing, which goes against the latter disjunct of VIM. Simply put, Elsa has no prior life to speak of. Even though they are physically indistinguishable, VIM says that Anna is a composite, but Elsa is not. But since they are indistinguishable,

surely Anna is a composite if and only if Elsa is a composite.

VIM allows for violations of what van Inwagen calls the duplication principle:

> If the *x*s compose something, and if the *y*s perfectly duplicate the *x*s (both in their intrinsic properties and in the spatiotemporal and causal relations they bear to one another), then the *y*s compose something. (van Inwagen, 1990, p. 138)

Without the duplication principle, it would be possible to have two physically indistinguishable collections such that the first composes something while the second does not (as currently seems to be the case with VIM and our frozen felines). The duplication principle is plausible given that duplicate collections differing with respect to compositional status seem strange. Van Inwagen notes that while he does not have an argument for it, the principle just seems true. For the sake of argument, take the duplication principle to be true. As such, Organicism needs a modification other than VIM to handle the duplication problem.

In defense of VIM, one might reply that Elsa is not really a duplicate of Anna according to the duplication principle. The temporal and causal history of Anna's parts is quite different from that of Elsa's parts, and perhaps that history ought to be included in the "spatiotemporal and causal relations" of Anna and Elsa's respective parts. This suggests two ways of reading the duplication principle: synchronically and diachronically:

> Synchronic duplication principle: If the *x*s compose something, and if the *y*s perfectly duplicate the *x*s synchronically, then the *y*s compose something.
>
> Diachronic duplication principle: If the *x*s compose something, and if the *y*s perfectly duplicate the *x*s diachronically, then the *y*s compose something.

The diachronic duplication principle seems highly plausible. If two collections of things are exactly alike, even down to their respective histories, it is hard to see how one of those collections could be composite while the other fails to be composite. However, VIM requires more than just the diachronic duplication principle. For VIM to work, the diachronic duplication principle must be true and the synchronic duplication principle must be false; although Elsa is not a diachronic duplicate of Anna, she is a synchronic duplicate of Anna. But the synchronic duplication

principle also seems quite plausible. Claiming that Anna is composite while frozen because her *x*s came from over here, but Elsa is not because her *x*s came from over there (the bad side of town) strikes me as odd. This would suggest that parts, right down to elementary particles, must be distinguished based on where and when they come from. But it seems likely in compositional matters that similar parts can substitute just as well for each other regardless of where and when we get them. At any rate, I concede that VIM works when limited specifically to a diachronic reading of the duplication principle, but I find this too restrictive. As further constraints reduce the overall likelihood of the view compared to similar options with fewer such constraints, it would be better to have a more flexible modification to Organicism that works diachronically or synchronically. The goal now is to modify Organicism such that Anna remains a composite while frozen, even if she is not alive in such a state, and the modification should also regard Elsa as a composite, which VIM fails to do. Let us consider some options.

3. Back to Organicism

Unmodified Organicism along with the intuition that a frozen organism is alive allows one to say that both Anna and Elsa, frozen or not, are composites. As such, one might be inclined to simply abandon VIM and reject any claim that a cryptobiotic organism is not alive, regardless of appearances to the contrary. Van Inwagen himself thinks frozen organisms are alive; even though large-scale biological activity has ceased, there are still processes going on at the micro level (e.g., particles of various sorts interacting), and these processes ordinarily constitute the larger-scale biological activity anyway. He refers to a frozen organism as a "living corpse," citing his fondness for oxymorons (van Inwagen, 1990, pp. 146-147).[2] Of course, this move is unavailable to any who do not share van Inwagen's intuitions about the status of suspended lives and van Inwagen wants Organicism to accommodate both sides of this intuitional divide. This requires a new modification.

4. Organicism+

Perhaps the simplest way of modifying Organicism would be to account for both living things and cryptobiotic things:

Organicism+: The *x*s compose *y* iff the activity of the *x*s constitutes a life or a cryptobiotic state.

Since Anna and Elsa's *x*s are each engaged in cryptobiosis, Anna remains composite while frozen and Elsa would be included as well. I have two main qualms with Organicism+. First, it seems ad hoc (though perhaps no more ad hoc than VIM itself). A single, generalized answer to SCQ seems preferable to a disjunction if only for simplicity.[3] Second, Organicism+ seems at odds with Organicism, or at least the spirit of Organicism. Supposing that cryptobiosis really is like death, even just temporary death, many of the reasons one might have for preferring Organicism are at least in tension with Organicism+. After all, a cryptobiotic organism may be more akin to a corpse than a life, but corpses are not composites according to Organicism. Still, there must be considerable difference between a cryptobiotic organism and a corpse (corpses tend not to come back to life), and this difference may be sufficient to blunt this second worry. In any case, I think there is a simpler option that captures everything Organicism+ does without coming across as ad hoc.

5. Counterfactual Modifications

Presumably, these cats would be alive if they weren't frozen, so perhaps all that is needed is something that captures this thought. As is often the problem with stating necessary and sufficient conditions, these conditions must be neither too narrow nor too broad. On first pass, one might think of something like the following:

> The *x*s compose *y* iff the activity of the *x*s constitutes a life or the *x*s would engage in activity that constitutes a life if the *x*s were in conditions conducive to life-constituting activities.

Freezing is not a condition conducive to life, and so this modification may seem to capture the right sorts of intuitions about the cat. Unfortunately, this initial attempt is much too broad. Consider the first cat, Anna. Anna at t_1 and t_3 is undoubtedly alive and thus, according to Organicism, a composite. But suppose Anna was deconstructed down to her constituent particles—her *x*s. We could then separate and organize Anna's material into various piles, much like Elsa's material before the scientist printed her out. In this deconstructed state, Anna's *x*s are clearly not engaged in activity that constitutes a life, and yet it seems that these *x*s would once again engage in life-constituting activities were we to properly piece Anna back together. After all, these are the same *x*s that not long ago did compose a life, so we know that they can compose a life when in the right conditions. As such, according to this counterfactual account, the pile

of *x*s that once composed Anna is a composite. However, it seems clear that these disassembled *x*s are nothing more than a pile, and piles are not composites according to Organicism.

This first attempt at a counterfactual modification results in a kind of mereological semi-universalism, where any *x*s that could be brought together to form a life count as a composite. This includes not only Elsa, Anna's frozen doppelganger, but also the material in the scientist's printer before Elsa was even printed. It may also suggest that Elsa (and Anna and every other potentially living thing) has existed for as long as her *x*s have existed, and this is true regardless of those *x*s' properties or relations to each other. So, while the initial counterfactual modification overcomes VIM's duplication problem, it faces a separate problem that VIM does not. As such, we can borrow from VIM to adjust accordingly:

> The *x*s compose *y* iff the activity of the *x*s constitutes a life or the *x*s, given their individual properties and relations to one another, would engage in activity that constitutes a life if the *x*s were in conditions conducive to life-constituting activities.

This is far narrower than the initial attempt, given its inclusion of properties and relations, allowing us to say that Elsa is a composite, while avoiding the semi-universalism of the prior modification. This can also be simplified, as any *x*s engaged in activity constituting a life must already be in conditions conducive to life-constituting activities. The first disjunct implies the second, so we can simplify by dropping the first. This leaves us with:

> Counterfactual Modification (CM): The *x*s compose *y* iff the *x*s, given their individual properties and relations to one another, would engage in activity that constitutes a life if the *x*s were in conditions conducive to life-constituting activities.

6. Disposed to Life

CM is construed similarly to conditional analyses of dispositions, such as the simple conditional analysis or David Lewis's analysis. The simple conditional analysis says that *x* is disposed at a particular time to respond to a particular stimulus iff, were *x* to undergo that stimulus at that time, *x* would produce the response. Lewis's analysis says that *x* is disposed at a particular time to respond to a particular stimulus iff, for some suitable property *x* has at that time, were *x* to undergo that stimulus at the initial

time and retain the property until a later time, *x* would produce the response (see Lewis, 1997). While CM does not exactly follow either of these analyses, it is close enough such that one could adjust CM to fully accord with either (depending on one's preferred analysis). As such, CM can be further simplified:

> Dispositional Modification (DM): The *x*s compose *y* iff the *x*s are disposed to engage in activity that constitutes a life.

Like CM, DM also handles the duplication problem faced by VIM. If Anna is as a composite because her *x*s are disposed thus and so, and if Elsa's *x*s perfectly duplicate Anna's *x*s, then Elsa is also a composite since Elsa's *x*s must also be disposed thus and so (Lewis, 1997, p. 148).

Having appealed to counterfactuals and conditional analyses of dispositions, one might be understandably suspicious of both CM and DM. Conditional analyses are thought to fall prey to various counterexamples (see Martin, 1994 and Bird, 1998). One might worry that CM likewise succumbs to similar counterexamples. Inasmuch as DM relies on conditional analyses of dispositions, DM may be in trouble as well. Fortunately, this worry highlights a significant advantage DM has over CM: there are more analyses of dispositions than just the conditional variety.[4]

Even if the conditional analyses are wrong, DM can still successfully modify Organicism by appealing to another analysis. For example, David Manley and Ryan Wasserman's proportional analysis and Barbara Vetter's possibility analysis also work. Manley and Wasserman's proportional analysis says that *x* is disposed to M in C iff some suitable proportion of C-cases are such that *x* would M in them (Manley and Wasserman, 2008, p. 76). Applying this analysis to DM results in something like:

> The *x*s compose *y* iff some suitable proportion of life-constituting conditions are such that the *x*s would engage in activity that constitutes a life in those conditions.

If Anna's parts would engage in activity that constitutes a life in a suitable proportion of cases, then Elsa's parts would too, since they are duplicates. Vetter's possibility analysis drops the ordinary requirement of stimulus or triggering conditions: *x* is disposed to M iff *x* can M (Vetter, 2014, p. 135). Applying this analysis to DM results in:

> The *x*s compose *y* iff the *x*s can engage in activity that constitutes a life.

If Anna's *x*s can engage in activity that constitutes a life, then Elsa's can too. Once again, they are duplicates. It should be noted that any analysis requires the same treatment of the *x*s in the case of CM. Namely, the properties and relations of the *x*s need to be included to avoid the issue of too many composites.

It must be stressed that no particular analysis of dispositions is being endorsed for use with DM. For the purposes of a modification, all that matters is that there are analyses of dispositions that allow Organicism to say that Anna is a composite at all of t_1, t_2, and t_3, and that Anna's frozen copycat, Elsa, is also a composite. Suppose all the previous analyses fail and are supplanted by a more promising analysis of dispositions. It seems likely that applying that analysis to DM (whatever it ends up being) would also yield the desired result of both Anna and Elsa being composites, even while frozen. DM overcomes the duplication problem, and so is preferrable to VIM. DM also works with more than just conditional analyses of dispositions, and so is preferable to CM as well.

7. Conclusion

VIM says that the *x*s compose *y* iff the activity of the *x*s constitutes or results from a life. DM says that the *x*s compose *y* iff the *x*s are disposed to engage in activity that constitutes a life. Both allow us to say that the cat is a composite at all of t_1, t_2, and t_3, which accords with fairly common intuitions about the status of suspended lives. However, VIM faces the duplication problem, while DM does not. As such, the proponent of Organicism should opt for DM rather than VIM.[5]

Notes

[1] My aim is to raise a new problem for Organicism and offer a way to address this problem. Note that I am not seeking to defend Organicism from all attacks; Organicism may face other issues. For example, David Vander Laan argues that Organicism and all other moderate answers to SCQ result in composition depending upon extrinsic factors, and such extrinsic dependence may come at too steep a cost (see Vander Laan, 2010). Vander Laan may well be right in his assessment, or one may find themselves with doubts about his argument akin to those had by van Inwagen (Vander Laan, 2010, p. 142). Either way, such further problems and arguments are beyond the scope of this paper.

[2] For what it's worth, I do not find this to be terribly convincing. Presumably, a frozen corpse would exhibit the same kinds of micro level processes but would

not be alive given that it is a corpse. As such, the micro level processes in a frozen organism do not seem sufficient to justify the claim that the organism is alive.

[3] Though perhaps an argument could be made in favor of disjoint, series-style answers to SCQ. I grant that this point is debatable.

[4] It is worth mentioning that we should not be too hasty to write off conditional analyses of dispositions. Sungho Choi argues that the simple conditional analysis (or something near enough) can overcome its supposed problems (see Choi, 2008). Those who find such arguments persuasive can take DM and CM to be expressing basically the same thing. Still, DM may be preferable for the sake of simplicity.

[5] My thanks to Alex Pruss, Mike Willenborg, colloquium attendees at Baylor University, and anonymous reviewers for their comments and suggestions.

Works Cited

Bird, Alexander. (1998) Dispositions and Antidotes. *The Philosophical Quarterly* 48(191): 227-234.

Choi, Sungho. (2008) Dispositional Properties and Counterfactual Conditionals. *Mind* 117(468): 795-841.

Clegg, James S. (2001) Cryptobiosis—a peculiar state of biological organization. *Comparative Biochemistry and Physiology Part B: Biochemistry and Molecular Biology* 128(4): 613-624.

Lewis, David. (1997) Finkish Dispositions. *The Philosophical Quarterly* 47(187): 143-158.

Manley, David and Ryan Wasserman. (2008) On Linking Dispositions and Conditionals. *Mind* 117(465): 59-84.

Martin, C. B. (1994) Dispositions and Conditionals. *The Philosophical Quarterly* 44(174): 1-8.

Neuman, Yair. (2006) Cryptobiosis: A new theoretical perspective. *Progress in Biophysics and Molecular Biology* 92(2): 258-267.

Van Inwagen, Peter. (1990) *Material Beings*. Cornell University Press.

Vander Laan, David. (2010) A Relevance Constraint on Composition. *Australasian Journal of Philosophy* 88(1): 135-145.

Vetter, Barbara. (2014) Dispositions without Conditionals. *Mind* 123(489): 129-156.