Folk Mereology is Teleological

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When does mereological composition occur? For instance, if a paper plate is positioned on a table between a plastic knife and a metal fork, does this scattered plurality of diverse objects make up a single composite object (a "table setting") or not? Or if two people shake hands, or even glue their hands together, does this connected or even bonded plurality of similar objects make up a single composite object (shaped like a sculpture of two people shaking hands) or not? Many metaphysicians have wanted a view of composition that fits with folk intuitions, and have charged leading views with failing to do so. For instance, Hirsch (2002: 60) declares that "the linguistic evidence indicates that fluent speakers of English do not speak the mereologist's language." And Markosian (1998: 211) sets out from the claim that "no one has yet defended a view… consistent with standard, pre-philosophical intuitions about the universe's composite objects."

Yet there is wide disagreement among metaphysicians as to what the folk intuit about mereological composition and why they do so, and no empirical discipline to the discussion. We see this situation as an opportunity to put the tools of experimental philosophy to constructive use. Accordingly we aim to discover when the folk tend to think that composition occurs, and why they do so. So our question is: *when do the folk think that mereological composition occurs*? That is, what is the folk theory of composition—*folk mereology*—against which metaphysical accounts might be measured?

Our question—beyond whatever intrinsic interest it might possess—should be of obvious interest to anyone interested in the psychological question of how humans conceptualize the world, or in the connected project of descriptive metaphysics. Whether our question is also relevant to prescriptive metaphysics is a matter of controversy. For those who take conformity with folk intuitions to be at least one desideratum of theory choice in prescriptive metaphysics, our question bears obvious relevance. But even those who would dismiss folk intuitions as altogether irrelevant to real metaphysics (either because they deny that *intuitions* should play any role, or because they deny that the intuitions of *the folk* should play any role) may still want to know what they would dismiss. Indeed, it seems to us that understanding the folk theory of composition is a precondition to considering whether it deserves to be taken seriously.

Our own view is twofold. First, we hold that the folk theory of composition is *teleological*, in that the folk tend to think that a plurality of objects has a fusion if and only if that plurality collectively serves a purpose. So, for instance, we predict that people will tend to say that composition has occurred with the knife, fork, and plate (since they collectively serve as a table setting) but not with the two people shaking hands (unless they are accorded a function). This view seems not even to be considered in the contemporary discussion, though it coheres with a wide swath of current psychological work on object concepts. Secondly, we regard such a folk theory as tied into a benighted teleological view of nature, and thus deserving *dismissal*. As such we think that understanding the folk theory of composition should actually lead us to liberate the discussion of when composition occurs from any demanded conformity with folk intuitions. On this matter, the folk deserve to be ignored.

Overview: In §1 we review the existing discussion about when composition occurs, with an eye to claims that have been made about what the folk think. In §§2-4 we use the methods of experimental philosophy to extract a teleological account of what the folk think, articulate some of the details, and

connect this to current psychological research on "promiscuous teleology" in our concept of an object. (Readers who prefer to take in the background psychological context before considering our results may read §4 before §§2-3.) Finally in §5 we address methodological issues about the role of folk intuitions in real metaphysics, having (we hope) achieved sufficient understanding of folk mereology to see why it should be ignored.

1. Composition and Intuition

When does mereological composition occur? The metaphysical debate often centers on claims about what common sense would say. Yet there is disagreement about what common sense would say and why it would say so, and no empirical basis to the dispute. We aim to document the role of folk intuitions in the metaphysical debate, in order to set the stage for an empirical investigation into folk mereology. In §1.1 we review the metaphysical debate, in §1.2 we display points at which folk intuitions are invoked, and in §1.3 we exhibit some competing armchair descriptions of the folk theory.

Before proceeding, we would clarify that the metaphysicians we discuss are not always explicit as to whose intuitions are relevant. Though we sometimes find explicit appeal to folk intuitions, we sometimes find appeals to some unspecified "we" or some disembodied "common sense." Accordingly we are not always certain if the authors we are quoting intend to be discussing what the folk think, or perhaps what the experts think, or what some ideal spirit of reason would think, or just what they believe. Those who do not intend to be discussing what the folk think because they do not think that folk intuitions are relevant to the debate should ultimately agree with our conclusion anyway. We return to this interpretive question in our concluding methodological discussion (§5.3).[1]

We would also clarify that we are not intending to criticize anyone. We are mainly documenting the many conflicting claims about folk mereology that have been issued from the armchair. We don't think that it is illegitimate to speak from the armchair, and we don't even think that it is illegitimate to speculate on empirical matters from the armchair.[2] Indeed we ultimately agree with all of the charges made about existing theories suffering from "madness" (§2; though we would add that this is a domain in which "sanity" proves to be a form of unenlightenment: §5). We only mean to be making the very modest methodological suggestion that, when so much weight is placed on folk intuitions, and when there is disagreement about what these intuitions are, some empirical work might help to advance the discussion.

As a final preliminary note, we would flag that teleological notions are almost completely absent from the current debate. Teleological notions do not come up when metaphysicians are presenting their own theories.[3] This is not so surprising: orthodoxy has it that teleological notions are a vestige of an obsolete conception of nature—"part of a superseded, pre-scientific muddle about how the world works" (Hawthorne & Nolan 2006: 267; c.f. Jenkins & Nolan 2008)—and thus unfit for real metaphysics. What is more surprising is that teleological notions do not come up even when metaphysicians are speculating

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[1] Korman (2010: 123) and Kriegel (2011: 196; 2008: 366-7) deserve special praise for being explicit about whose intuitions they consider to be relevant and when. For Korman what is relevant are the particular case intuitions of the experts, while for Kriegel what is relevant are the particular case intuitions of the folk (in normal circumstances, for normal cases).

[2] We consider it an empirical matter—on which we are not prepared to speculate—as to how reliable empirical speculations from the armchair are, in various domains. See Dunaway, Edmonds & Manley (*forthcoming*) for some empirical evidence that philosophers do tend to be decently reliable on somewhat related issues.

[3] The literature is vast and of course there are exceptions to the general rule. For instance, Rea (1998: 354) speaks of functional organization as sufficient for composition. (Our thanks to Dan Korman for the reference.)

about what the folk think. It almost seems as if the metaphysicians regard teleology as being so muddled that they cannot charitably imagine the folk wallowing in it.[4]

1.1 The special composition question
When does mereological composition occur? That is, under what conditions does some plurality of individuals x_1-x_n compose some one individual y? This question is what van Inwagen (1990: 30) calls the "special composition question," and it has set the agenda for one of the main debates in metaphysics spanning the last two decades.

Strictly speaking, we—following van Inwagen—are focused on a question that is more restricted in two respects. First, we are only focused on when composition occurs *for material objects*. So in what follows all quantifiers should be read as restricted to material objects (unless the local context makes obvious otherwise). Perhaps mereological composition can occur among events or among abstract objects or among entities of some other sort, or even across categories of objects. Such is not our concern.[5] Secondly, we are only interested in when *many* make one. It is standard to use "plurality" in a way that is actually number *neutral*, allowing for pluralities of one or more individuals. With "degenerate pluralities" of just a single individual, it is trivial that composition occurs (everything composes itself). It is smoother to state the views in ways that ignore degenerate pluralities, and so we follow suit. Bringing this together, a more explicit formulation of our question is: under what conditions does some non-degenerate plurality of material objects x_1-x_n (for $n \geq 2$) compose some one material object y?

The literature offers a wide variety of proposed answers to the special composition question. Perhaps the most standard answer is *always, under any condition whatsoever*. This is the answer of the Universalist (built into the classical extensional mereology of Lesniewski and Goodman [c.f. Simons 1987: 37-41], and defended by Lewis 1991). A second sort of answer to this question is *never, under no condition whatsoever*. This is the answer of the Nihilist (explored by Rosen & Dorr 2002, and recently advocated by Sider 2013). Various intermediate answers are considered as well, such as *sometimes, when the plurality is in contact*, and *sometimes, when the plurality constitutes a life* (the former is van Inwagen's first "representative answer," and the latter is his final considered position).

Without further discussion, we will simply tabulate various answers in the current literature. This table is not intended to be exhaustive, but just to illustrate the variety of options under consideration:[6]

Universalism (Lesniewski, Goodman, Lewis)	Composition always occurs
Nihilism (Rosen & Dorr, Sider)	Composition never occurs
Contact (van Inwagen's first illustrative view)	Composition occurs when the plurality is in contact
Fastening (van Inwagen's second considered view)	Composition occurs when the plurality is fastened together
Vitalism (van Inwagen's final considered view)	Composition occurs when the plurality constitutes a life
Emergentism (Merricks)	Composition occurs when the plurality exhibits novel collective powers

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[4] It is a known bias of experts, that they tend to attribute their own more sophisticated views to the folk (c.f. Sytsma & Machery 2010).

[5] There is debate as to whether there is a single category-neutral relation of composition, or perhaps a range of analogous category-restricted relations (c.f. van Inwagen 1990: 18-20). On the one hand we do use 'part' for relations not just among material objects, but also among spatiotemporal regions, events ('the inning is part of the baseball game'), and abstracta ('the chapter is part of the book,' 'the hypotenuse is part of the triangle'). On the other hand it is not obvious that all of these are literal applications of one and the same neutral notion. We also use temporal notions in describing abstracta ('the sequence converges rapidly'), but no one takes this to indicate that we need a single neutral account of time that equally covers abstracta.

[6] Serialism and Brutalism differ from the preceding seven views on the table over whether a general and informative answer to the special composition question can be given, though this difference plays no role in our discussion.

Regionalism (Markosian's latter view)	Composition occurs when the fusion of the regions occupied by the plurality is occupied by an individual
Serialism (Sanford)	Composition occurs if the plurality is so and this condition is met, or if the plurality is such and that condition is met, or if the plurality is thus and the other condition is met, or …
Brutalism (Markosian's earlier view)	Composition occurs when it does, as a brute matter of fact

1.2 Mereological madness
Virtually every single view on the table as to when composition occurs has been charged with violating common sense, though the charges are almost always disputed. In this vein Markosian (*forthcoming*: §2) charges the leading views with generating "wildly counterintuitive consequences" and so succumbing to "mereological madness."

To begin with, Universalism—due to its being the most standard answer to the special composition question, and the most permissive—has been subject to the longest litany of such charges. It is often said that Universalism posits bizarre fusions which common sense would reject. Here is a representative quote, from Hirsch (2002: 60):

> I understand perfectly well what it means to talk (in plain English) about such things as cars, bees, human beings, books, and the Eiffel Tower, or even to talk about such marginal things as noses and car-hoods. But it's crazy to say (in plain English) that there exists something composed of my nose and the Eiffel Tower.

Indeed Markosian (1998: 228) considers this sort of charge to be "a fatal objection" to Universalism, and Kriegel (2011: 198) tells us (from the armchair) what the folk will think: "Commonsense shuns [arbitrary] fusions, but… mereological universalists… embrace them. The folk's intuitive verdicts will be *against* 'there is a fusion of this table and the moon'…"

But Universalists have usually rejected this charge. Thus Korman (2008: 320; c.f. van Inwagen 1990: 75) observes: "[U]niversalists typically take the view to be entirely compatible with what the folk say in ordinary discourse about material objects." In this vein, Lewis (1991: 80), discussing the fusion of the front half of a trout with the back half of a turkey, explains away hesitation to affirm existence via quantifier domain restriction:

> Only if you speak with your quantifiers wide open must you affirm the trout-turkey's existence. If, like most of us all the time and all of us most of the time, you quantify subject to restrictions, then you can leave it out.

And in a slightly different vein, Thomasson—who (2007: 3) explicitly aims to show "how, reflectively, we can make sense of our unreflective common sense worldview"—maintains (2007: 183) that the folk simply have no view one way or another on arbitrary sums, never having considered them:

> Certainly it is true that common sense does not recognize the existence of gollyswoggles, mereological sums, and the like. Nor, of course, does it *deny* their existence—There are no terms in ordinary English for these things, and common sense understandably does not consider such things at all, since given our current range of practices, such entities would be quite irrelevant and uninteresting.

Indeed she (2007: 184) then speculates that if "we explained to 'normal' people" a term for some arbitrary sum, and then asked them if there is such a thing, they "would certainly accept that there is."

So we find a debate over what the folk think. Is Universalism a form of "mereological madness" or "entirely compatible with what the folk say"? We see little prospect in settling this debate without any empirical evidence.

We find comparable debates over many of the alternatives to Universalism. For instance, Nihilism has equally been subjected to charges of violating common sense. Thus Bennett (2009: 44) notes that "most of us believe in composite objects like tables, trees, and toasters." Schaffer (2009: 358) offers "my body has proper parts (e.g. my hands)" as a "biological banality." And Kriegel (2011: 198) has us imagine a normal subject ('Jane Sixpack') who says that a table is present, and says of this imaginary case: "It is clear that Jane Sixpack's intuitions are the way they are precisely because she is beholden to the common-sense view about what there is and what there is not."

Some Nihilists—such as Rosen & Dorr (2002)—have flirted with the idea of treating the folk as speaking non-literally on these occasions, perhaps via a tacit "according to the fiction that mereological composition occurs" operator. Rosen & Dorr (2002: 158) ultimately go in for a more nuanced view on which the folk are speaking literally on these occasions but unreflectively, and would on reflection no longer dismiss Nihilism:

> *Unreflective* common sense comes down squarely on the side of ["There is a house on the corner"] But upon reflection it emerges that in taking this stance, common sense is excluding an alternative ["There are merely some things arranged house-wise on the corner"] without having considered it, an alternative which, so far as we have yet been able to see, is undetectably different from the preferred alternative, and which, upon reflection, common sense hesitates to exclude.

So again we find a dispute over what the folk think, this time concerning not just initial intuitions but their resilience. Again we see little prospect in settling this debate without empirical work.

Contact and Fastening have both been charged with counterintuitive results in van Inwagen's famous "handshake" case. Thus van Inwagen, after allowing (1990: 34) that Contact "has a certain intuitive appeal," goes on (1990: 35) to offer a counterexample:

> Suppose you and I shake hands. Does a new thing at that moment come into existence, a thing shaped liked a statue of two people shaking hands, a thing which has you and me as parts and which will perish when we cease to be in contact? Is there an object that fits just exactly into the region of space that you and I jointly occupy? Not in my view.

Fastening, which Markosian (1998: 223) says "is no doubt very close to the common sense view" and comes very close to capturing "the average person's initial response," is then faced with extensions of this counterexample (as are strengthened views requiring cohesion and fusion). Thus van Inwagen (1990: 57-59) continues:

> Suppose once more that you and I shake hands, this time after I have smeared my hand with one of those glues whose manufacturers warn us that they "bond skin instantly." No new thing comes to be in the course of our subsequent painful adventure.

Van Inwagen himself does not appeal to intuitions beyond his own, though Markosian (1998: 224) adds that the idea that the handshake makes for a new composite object "seems (to many people at least) to be an unacceptable consequence." Indeed, this is one of the few intuitions in the literature that stands undisputed. Here we see strong claims made on behalf of common sense, which, though undisputed, remain empirically unsubstantiated.

Vitalism also has been charged with counterintuitive consequences, including failing to recognize many of the artifacts like tables and toasters that Nihilism is charged with failing to countenance. On this matter Hirsch (2002: 67) imagines the Vitalist declaring: "All things considered, I am tentatively inclined to be ontologically committed to apple trees but not to apples." Hirsch continues: "The challenge for the shallow ontologist posed by this kind of formulation is how to keep a polite straight face while listening to it." But—reverting to our pattern—we find van Inwagen (1990: 103) contesting the claim, saying: "It is far from obvious, however, that it is a matter of Universal Belief that there are chairs." He (1990: 103-4) then adds:

> In my view, my general thesis about what there is—that the only physical things are simples and living organisms—is not inconsistent with anything believed *ubique et ab omnibus*. In my view, my metaphysics does not shut me off from Universal Belief.

Emergentism has been charged with a similar range of counterintuitive consequences (no toasters or tables, neither apples nor apple trees). Although Merricks—Emergentism's spokesperson—does not dispute the charges, but instead takes his burden to be explaining why the folk have the false beliefs they do, and so gives an account (2001: 171) of how the folk claims are "nearly as good as true," coupled with (2001: 75) the claim that our intuitions about the occurrence of composition are merely "a matter of conventional wisdom and local culture."[7]

With Regionalism, Serialism, and Brutalism matters are more subtle. Each view can and has been recommended for at least not violating folk intuition. Although, as Markosian (*forthcoming*: §5) notes, these views only count as not violating folk intuition by *falling silent* on every single case: "[The Spatial Approach] has no implausible consequences regarding specific cases of composition (because, like Brutal Composition, it has no such consequences of any kind), …" Whether it counts in favor of a view to fall silent is a matter that is beyond the scope of the current discussion.[8]

There is another view we have not included on our table which is guaranteed by construction to match folk intuitions. This is the *secondary quality* view, defended by Kriegel (2008), which takes composition to occur when the folk would intuit that it occurs. Such a view only counts as not violating folk intuition by *blindy following* the folk in every single case. No informative independent condition on when composition occurs is provided. As such this view may yield exactly the same verdicts as Universalism, or Nihilism, etc. We cannot know what verdicts this view yields until we know when the folk tend to intuit that composition has occurred. And we cannot know whether the policy of blindly following the folk is a wise policy until we know why the folk think as they do.

We have documented some of the ways in which folk intuitions have been both invoked and disputed in the debate over composition. We cannot help but think that some empirical evidence might help advance the debate.

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[7] We thus ultimately agree with Merricks that his view (and others) violate folk intuitions, and that the folk intuitions should not be respected but rather explained away. Merricks does not detail what he means by "conventional wisdom and local culture" (for instance we do not think he is committed to the explanation coming from culture rather than nature). We are attempting to offer an empirically substantiated account of how and why the folk intuitions should be explained away, as arising from the teleological biases of our cognitive system.

[8] It might be natural to say that falling silent is better than speaking in conflict with common sense but worse than speaking in agreement with it. But then in order to rank theories one would still need to know what common sense says (in order to discern conflicts from agreements among the theories that do not fall silent). And in order to justify preferring to fall silent than to speak in conflict with common sense, one would still need to understand the folk theory (in order to determine if it deserves consideration).

1.3 Accounts of the folk theory

Metaphysicians have not stopped at saying *what* the folk think about composition; they have gone on to speculate as to *why* the folk think as they do. That is, metaphysicians have gone on to speculate about the underlying folk theory of composition. And they have done so without any empirical evidence, and in conflicting ways.

As a first representative example, Lewis (1986: 211) offers:

> We are happy enough with mereological sums of things that contrast with their surroundings more than they do with one another; and that are adjacent, act together, and act jointly. We are more reluctant to affirm the existence of mereological sums of things that are disparate and scattered and go their separate ways.

Thus for Lewis, "we" are focused on qualities, locations, and causal connections, in ways that sound to us like echoes of Hume's (2000: 417) empiricist psychology on which resemblance, contiguity, and causation are "*to us* the cement of the universe."

An even stronger focus on causal connections (and a downplaying of qualitative constancy) can be found in Hoffman and Rosenkrantz's (1997: 73) discussion, which begins from the following assertion: "According to a key commonsense intuition, there is a relation that unites parts which compose a compound physical object." This uniting relation is then analyzed (1997: 80-90) in terms of the parts being pairwise joined, with such joining understood (roughly speaking) in terms of the possibility that pulling or pushing the one pulls or pushes the other.

A subtly distinct account is suggested by Simons (1987: 290), who takes up the idea that composition requires some form of integration:

> Implicit in the criticism of mereological theories which permit the existence of arbitrary sums is the view that something cannot count as an individual, as *one* object, unless it is possessed of a certain degree of integrity or internal connectedness.

Though for Simons (1987: 303) this integration is to be understood not in terms of causation but in terms of ontological dependence, with an integrated thing being one that does not depend on anything that is not a part of it.

And as a final example, in contrast to all of these approaches just listed, Rosen & Dorr (2002: 152) explicitly deny that common sense has any general rule or theory beyond its firm opinions on particular cases:

> Naïve common sense apparently has it that small things sometimes come together to form larger things. Common sense does not deliver an explicit rule or principle governing composition. But it does have firm opinions about particular cases. The particles in a chemical atom, the cells in your body, the cards in a house of cards, the stars and planets in the Milky Way galaxy:— by commonsensical standards these are all cases in which several things compose a single thing.

So what is the folk view of when composition occurs? Is there even such a thing as a folk theory, beyond a smattering of firm opinions? Again we cannot help but think that some empirical evidence might help advance the debate.

2. The Folk Theory is Teleological

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So far we have displayed a range of disputes about when the folk think composition occurs, and why they are said to think so, all conducted without any real empirical basis. We see this situation as an opportunity to put the tools of experimental philosophy to constructive use. So without further ado, we turn to reporting our results. In §§2.1-2.5 we reveal a range of new studies which lead to the idea that the folk have a teleological view, intuiting that a plurality of objects have a fusion when that plurality serves a purpose.

Before proceeding, we would make explicit that our results are preliminary in multiple respects. First of all, as with any empirical work, our results are subject to potential confounds and diverse interpretations, and defeasible in the light of future inquiry. We think that any open-minded person who considers all of our studies together will agree that they point overall towards some form of teleological view. But each specific study may be questioned, and of course future results may always point in other directions, or towards a more specific form of a teleological view. Overall we hope to have provided the first but not the last word on folk mereology.

We would also flag the methodological difficulties arising in exploring folk mereology. Simply asking people the special composition question directly ("Under what conditions does some plurality of individuals x_1-x_n compose some one individual y?") will presumably elicit something between blank incomprehension and pure noise. Attempting to teach the relevant concepts first comes with no guarantee of success (and may generate bias, and will generate cognitive load). So instead we chose to design a variety of surveys describing various particular cases and then posing composition questions in various ways (e.g., do two mice glued together "compose a new object"? do two ropes tied together "create a single, unified object" or still leave one with "two, distinct pieces of rope"?) We hoped that our results might prove *robust* across these diverse vignettes and probes, thereby buttressing the conclusion that we have been uniformly successful in eliciting the intended mereological concepts. Our hopes turn out to be realized. But still, we would flag the concern that some of our questions may have been read in an unintended way.

As a last preliminary, we would note that we did not at all expect the findings we are reporting. We actually began with the hypothesis—in line with the Lewis and Thomasson view reported in §1.2— that the folk were Universalists. The teleological view was not even on the map for either of us when we began, just as it is off the map for other contemporary metaphysicians (§1). It was only when our participants started leaving comments on our pilot studies like "it takes some kind of functionality to make it a new object," "When one or more items come together and it serves a purpose," and "An object that wasn't there previously and serves a functional purpose," that we started to wonder if we might have overlooked something.[9]

Once the teleological view came onto the map for us though, it came to seem retrospectively obvious. This is a perspective on the world that one finds in Aristotle, and a perspective on folk theory that is sustained in the leading psychological theories of object concepts (§4). Our notion of an object was formed in the primordial conceptual ooze, encrusted with teleological muck. (The reader who prefers to take in the background psychological context first may skip ahead to §4 at this point.)

2.1 Handshake cases
When do the folk think that mereological composition occurs? It might prove best to begin with studies we ran based on van Inwagen's handshake case (§1.2). Recall that van Inwagen—after hypothesizing that the folk theory is something like Contact or Fastenation—asks us to imagine two people shaking hands

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[9] Ned Markosian (*personal communication*) tells us that he has (in his book manuscript in progress) now considered the idea that composition occurs when the components collectively perform a function, since "my anecdotal evidence evidence points in the same direction as your X-phi research."

(thereby coming into contact), or even gluing their hands together (so as to become fastened together), and then to consider whether "a new thing" has "at that moment come into existence." If the folk theory were based on Contact or Fastenation we should think "yes." But if the folk theory were based on Nihilism, Vitalism, or Emergentism we should think: "no, there is no sum, nothing has coming into existence." While if the folk theory were based on Universalism we should think: "no, there always was a sum—nothing *new* has come into existence." (If the folk theory were based on Regionalism, Serialism, or Brutalism then no prediction can be made one way or another.)

So we tested van Inwagen's initial question, as to whether two people shaking hands and thereby coming into contact thereby create a new thing. We set up a handshake, and then described a disagreement between two characters—Andy and Liz—as to whether a new larger object was created in the moment of the handshake:

> *Handshake*
> Sally and Tom are leaders of rival political factions, and have recently decided to lay aside their differences. They have worked out all the details, signed all the official papers, and will now seal their deal with a public and historic handshake.
>
> Later that day, Andy and Liz—who were both present for the historic handshake—have a disagreement over whether Sally and Tom created a new object when they shook hands. Andy says that simply coming into contact with someone or something is not enough to create some new thing, and claims that Sally and Tom did not create a new larger object in the moment when they shook hands.
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> Liz, however, disagrees. She thinks that when Sally and Tom came into contact in this case, they thereby created a new larger thing, made from Sally and Tom together.

Participants were asked the extent to which they agreed with either Andy or Liz (they were given a seven point scale with 1 marked "Andy is right," 4 marked "Neither is right," and 7 marked "Liz is right"). Just as van Inwagen predicted, participants tended to side with Andy (M=2.48, SD=1.84).

We then adjusted the vignette so that the larger object served a purpose, by adding that a sculptor would use it as a model for a sculpture:

> *Handshake with function*
> Sally and Tom are leaders of rival political factions, and have recently decided to lay aside their differences. They have worked out all the details, signed all the official papers, and will now seal their deal with a public and historic handshake. To commemorate this historic event, a sculptor has been commissioned to sculpt the handshake. Sally and Tom together, while they are shaking hands, will be providing a model for the sculpture, which will be dubbed "Unity"
>
> Later that day, Andy and Liz—who were both present for the historic handshake—have a disagreement over whether Sally and Tom created a new object when they shook hands. Andy says that simply coming into contact with someone or something is not enough to create some new thing, and claims that Sally and Tom did not create a new larger object in the moment when they shook hands.
>
> Liz, however, disagrees. She thinks that when Sally and Tom came into contact in this case, they thereby created a new larger thing, made from Sally and Tom together, which served to provide a model for the sculpture.

With this small adjustment, we were able to flip intuitions. Suddenly participants tended to side with Liz (M=4.86, SD=1.60), agreeing that "when Sally and Tom came into contact in this case, they thereby created a new larger thing, made from Sally and Tom together, which served to provide a model for the sculpture." Here is a visual depiction of the effect of function on intuitions:[10]

Handshake cases
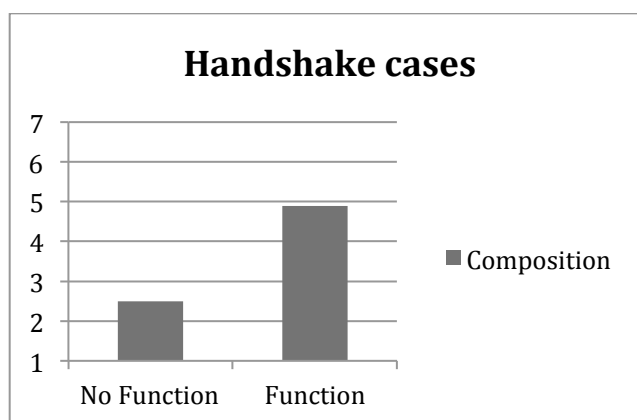
None of the extant answers to the special composition question (§1.2) predicts this pattern. Universalism, Nihilism, Fastening, Vitalism, and Emergentism all predict that no new object is created in both cases (Universalism predicts that no *new* object is created, the others predict that there is no composite object at all). Contact predicts that a new object is created in both cases. And Regionalism, Serialism, and Brutalism make no predictions at all. None of the extant answers to the special composition predicts any difference as to whether composition occurs, on the basis of whether or not the larger thing serves a purpose (e.g. provides a model for a sculptor). To the extent that metaphysicians are beholden to folk intuitions, we have just provided a counterexample (indeed, an empirically substantiated counterexample) to every account.

Indeed none of the extant armchair hypotheses about the folk theory (§1.3) predict this pattern. Never mind whether the folk are said to focus on qualitative continuities, causal connections, or ontological dependencies. None of those factors change between *Handshake* and *Handshake with function*.

With these Handshake cases we see a first sign of an underlying pattern, in which intuitions about whether or not composition occurs are driven by whether or not there is a function for the candidate larger thing to serve. Our remaining studies further illustrate and clarify this pattern.

2.2 Gollywag cases

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[10] A total of 62 participants were recruited through Amazon's Mechanical Turk and randomly assigned to either *Handshake* or *Handshake with Function*. After reading the case and indicating who they agreed with (Liz or Andy), participants were then taken to a separate page where they answered three comprehension questions:
1. Sally and Tom are leaders of rival political factions (yes/no)
2. Andy thinks that the handshake did not create a larger object (yes/no)
3. Liz thinks that the handshake did create a larger object (yes/no)

Four participants missed one or more comprehension questions in *Handshake* while three participants missed one or more comprehension questions in *Handshake with Function*. After excluding these participants, a total of 55 responses were analyzed using a one-way analysis of variance. We found that whether or not the larger object served a purpose produced significant effects of people's composition judgments $F(1, 55)=26.824, p<.001$.

In another series of studies we wanted to consider an unfamiliar type of artifact (we called these 'gollywags') and consider the effect of function along multiple dimensions. We wanted to see whether there was an effect of function, and also look for any interactions with contact or with fastening. So we began with:

Gollywags with fusion
Acme Inc. is a large research company. Two Acme Inc. researchers, Jones and Smith, have recently discovered a new thing, a "gollywag." Nobody has ever seen or heard of such a thing so Jones and Smith were quite surprised to stumble upon this new thing.

One day, Jones takes two gollywags and superglues them together. He thinks that he has created a new object.

Later that same day, Smith and Jones have a disagreement over whether the arrangement of gollywags composes a new object. Smith claims that the arrangement of gollywags does not compose a new object at all. He claims that simply supergluing some stuff together with some other stuff is not sufficient to compose a new object.

Jones, however, disagrees. He claims that simply supergluing some stuff together with some other stuff is sufficient to compose a new object. Concerning the specific case that they are considering, Jones concludes that the arrangement of gollywags does compose a new object.

We also had a *Gollywags with contact* case, just like *Gollywags with fusion* except that Jones, instead of supergluing the gollywags together, simply placed them into contact with one another.

We compared *Gollywags with fusion* with a case that added a function for the superglued gollywags, namely:

Gollywags with fusion with function
Acme Inc. is a large research company. Two Acme Inc. researchers, Jones and Smith, have recently discovered a new thing, a "gollywag." Nobody has ever seen or heard of such a thing so Jones and Smith were quite surprised to stumble upon this new thing.

Jones is a very hard worker and spends long hours in his office, spending most of his time sitting at his desk. On most days, his back becomes very sore from sitting for so long at his desk.

One day, Jones is working at his desk as he usually does. His back starts to become very sore from sitting for so long. He decides that he will take two of the gollywags and superglue them together, making what he thinks to be a new object, what he calls the "Gollywag-Supporter".

He places the Gollywag-Supporter on his desk chair and continues to work. At the end of the day, his back is not sore at all.

The next day, Smith and Jones have a disagreement over whether the arrangement of gollywags composes a new object. Smith claims that the arrangement of gollywags does not compose a new object at all. He claims that simply super-gluing some stuff together with some other stuff is not sufficient to compose a new object.

Jones, however, disagrees. He claims that simply supergluing some stuff together with some other stuff is sufficient to compose a new object. Concerning the specific case that they are considering,

Jones concludes that the arrangement of gollywags does compose a new object, namely a Gollywag-Supporter.

We also had a *Gollywags with contact with function case*, just like *Gollywags with fusion and function* except that Jones—instead of supergluing the gollywags together—simply placed them into contact with one another.

We found—in line with our handshake cases (§2.1), and not in line with any of the extant answers to the special composition question—that function continued to influence judgments about composition. We also found no effect of contact versus fusion (thus undermining the idea that causal joining plays a significant role in our intuitions), and no interaction between the presence or absence of function and the presence of contact or fusion, as may be visualized in:[11]
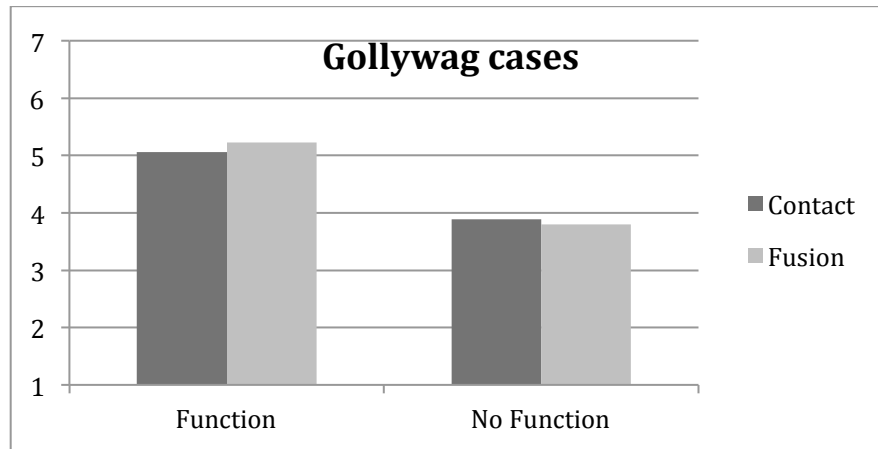
With the Gollywag cases we thus see a continuation of the underlying pattern of teleologically driven intuitions. Further, we see that other factors, in particular the kind of causal connectedness or joining that fastening adds to contact, seem to play no role in folk intuitions about when composition occurs, either alone or in interaction with function.

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[11] 121 participants were recruited from Amazon's Mechanical Turk, and randomly assigned to one of four conditions. After reading the case, participants were asked the extent to which they agreed with either Jones or Smith (they were given a seven point scale with 1 marked "Smith is right," 4 marked "Neither is right," and 7 marked "Jones is right"). Participants were then given, on a separate page, three comprehension questions:
1. Jones and Smith were talking about what is required to create a new thing (yes/no)
2. When Jones said that supergluing two things together [putting two things into contact] is sufficient for creating a new thing, what he was saying was that if you superglue any two things together [put any two things into contact with one another], then that is enough to create a new thing (yes/no)
3. Suppose someone said that supergluing two things together [putting two things into contact] is sufficient for creating a new thing. If that person were to take a wheel and a piece of metal and then superglue them together [put them into contact with one another], then that person would think that a new thing was created (yes/no)

Six people were excluded from the data analysis for failing at least one of the control questions. Analyzing the remaining 115 responses using a two-way analysis of variance, we found that whether the gollywags had a function or not strongly influenced people's judgments $F(1, 115)=11.647$, $p<.001$, with people tending to disagree that the gollywags composed an object when the gollywags had no function (M=3.85, SD=2.04) and agreeing that the gollywags composed an object when they had a function (M=5.15, SD=1.99). There was no effect of the relation type (contact, fusion) on people's composition judgments $F(1, 115)=.010$, $p=.919$ and there was no interaction between function and relation type on people's judgments $F(1, 115)=.113$, $p=.738$.

2.3 Mouse cases

With our Gollywag cases we looked at composition judgments for artifacts. We wanted to see if the same pattern of intuitions extended for biological organisms, and we also wanted to explore potential effects of familiarity, and of having a name to label the larger thing. So we began with familiar organisms—mice— and looked at the effect of function between:

> <u>*Mice with fusion*</u>
> Acme Inc. is a large research company. Two Acme Inc. researchers, Jones and Smith, are experimenting with mice.
>
> One day, Jones takes two mice and superglues them together. He thinks that he has created a new object.
>
> Later that same day, Smith and Jones, have a disagreement over whether the arrangement of mice composes a new object. Smith claims that the arrangement of mice does not compose a new object at all. He claims that simply supergluing some together with some other stuff is not sufficient to compose a new object.
>
> Jones, however, disagrees. He claims that simply supergluing some stuff together with some other stuff is sufficient to compose a new object. Concerning the specific case that they are considering, Jones concludes that the arrangement of mice does compose a new object.

And:

> <u>*Mice with fusion and function*</u>
> Acme Inc. is a large research company. Two Acme Inc. researchers, Jones and Smith, are experimenting with mice.
>
> The FBI has commissioned Jones and Smith and given them the task of determining whether mice can be used to sniff out explosives. Typically, dogs are used to sniff out explosives but in some cases dogs are way too large to enter certain types of spaces. So, the FBI wants to see if a smaller creature can sniff out explosives with the same degree of accuracy as a dog.
>
> For many months, Jones and Smith have been running the mice through various types of mazes, trying to determine how quickly and accurately the mice can find explosives. But, they are having little luck: the mice are much slower and much less accurate than dogs in finding explosives.
>
> One day, Jones takes two mice and superglues them together. He runs a wide range of experiments and finds that when the two mice are superglued together they are both very fast and highly accurate at detecting explosives. As a matter of fact, when two mice are superglued together, they are both faster and more accurate than dogs at detecting explosives. Jones thus thinks that he has created a new object, the "Mini-Bomb Detector".
>
> The next day, Smith and Jones have a disagreement over whether the arrangement of mice composes a new object. Smith claims that the arrangement of mice does not compose a new object at all. He claims that simply super-gluing some stuff together with some other stuff is not sufficient to compose a new object.
>
> Jones, however, disagrees. He claims that simply supergluing some stuff together with some other stuff is sufficient to compose a new object. Concerning the specific case that they are considering,

Jones concludes that the arrangement of mice does compose a new object, namely a Mini-Bomb Detector.

Alongside all of this, we also wanted to explore potential effects of familiarity, and of having a name to label the larger thing. So we looked at counterpart cases in which we replaced the mice with an unfamiliar sort of organism, for which we again used 'gollywag.' And we also looked at further counterpart cases in which we deleted the label 'mini-bomb detector,' to check if the presence of the label was influencing intuitions.[12]

Our results confirmed and extended the results of our handshake and gollywag (artifact) cases. We continued to find a strong influence of function on judgments about composition, and we found no other effects (either alone or in interaction). Whether the organisms were familiar (mice) or unfamiliar (gollywags), and whether they were jointly labeled (a 'mini-bomb detector') or left unlabeled seemed to make no difference to intuitions. All that seemed to drive intuitions was whether or not the candidate larger thing served a purpose. Since only function had an effect on composition, we've aggregated responses across all remaining conditions in the following visualization:[13]

Mouse cases

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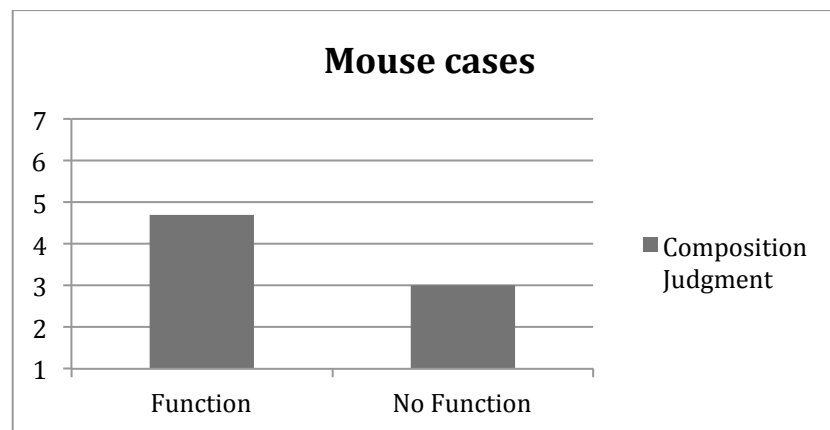
[12] We thus had a 2 (Function: Yes, No) x 2 (Label: Yes, No) x 2 (Familiarity: Gollywag, Mouse) design which resulted in a total of six conditions.

[13] 212 participants were recruited from Amazon's Mechanical Turk, and randomly assigned to one of six conditions. After reading the case, participants were asked the extent to which they agreed with either Smith or Jones (they were given a seven point scale with 1 marked "Smith is right," 4 marked "Neither is right," and 7 marked "Jones is right"). Participants were then given, on a separate page, five comprehension questions:

1. Jones said that supergluing the [gollywags/mice] together did create a new object (yes/no)
2. Smith said that supergluing the [gollywags/mice] together did not create a new object (yes/no)
3. Suppose someone said that supergluing two things together is sufficient for creating a new thing. If that person were to take a wheel and a piece of metal and then superglue them together, then that person would think that a new thing was created (yes/no)
4. When Jones said that supergluing two things together is sufficient for creating a new thing, what he was saying was that if you superglue any two things together, then that is enough to create a new thing (yes/no)
5. Jones and Smith were talking about what is required to create a new thing (yes/no)

Eight people were excluded from the data analysis for failing at least one of the control questions. Analyzing the remaining 204 responses using a three-way analysis of variance, we found that having a function or not produced a strong effect on whether people judged that the arrangement of mice or gollywags composed a new object $F(1, 204)=30.115$. $p<.001$: when the mice or gollywags served a function people judged that they composed a new object (M=4.7, SD=1.15) but when they did not serve a function people denied this (M=3.0, SD=1.73). Neither Label $F(1, 204)=.033$, $p=856$, Familiarity $F(1, 204)=.219$, $p=.640$, nor any two- or three-way interactions were found (all p's $>.05$).

With the Mouse cases we thus see a continuation of the underlying pattern of teleologically driven intuitions. Further, we see that other factors including familiarity and labeling seem to play no role in folk intuitions about when composition occurs.

2.4 Avalanche cases
Our cases so far have been limited in two main respects. First, we have only looked at artifacts and organisms, for which teleological thinking might seem natural. We have not yet looked at natural non-biological things (e.g. rocks). Secondly, we have only looked at larger things that are at least spatiotemporally connected, and sometimes even fastened together. We have not yet looked at scattered things, so left open whether there still might be some effect of scattering versus contact, or some interaction between scattering and function. So we turned to cases involving a scattered collection of rocks, to see if attributing a function (having the rocks designed to serve as a rock garden) would have an effect, and to continue checking for effects of labeling. We also wanted to start getting "inside" the notion of a function (which will be the topic of §3), by comparing the case in which a thing was designed from the start to serve a function, with the case in which a thing has already come to be (seemingly by accident) and is then accorded a function after the fact.

For these cases we began with:

Avalanche (base)
Jones lives on the side of a mountain. He has just been awoken by a series of loud crashes from a small avalanche on the mountain. Jones wakes up and looks outside, and sees a bunch of rocks strewn across his lawn from the avalanche.

We wanted to vary whether or not the rocks were given a label, whether or not they were accorded a function as a rock garden, and whether or not Jones then rearranged the rocks so that they were actually designed to serve that function. This resulted in six different extensions of *Avalanche (base)*:

Avalanche
[*Avalanche (base)* plus] Though he is surprised, he just goes back to bed.

Avalanche with label
[*Avalanche (base)* plus] He thinks to himself, "Looks like I have mountain man's rock garden!" He goes on thinking to himself, "What a useless mess—looks like I'll have to clean all this up in the morning."

Avalanche with accorded function
[*Avalanche (base)* plus] Even though avalanches are usually quite annoying for Jones, he decides at that moment that the rocks are actually strewn across his lawn in such a way that they will make his front lawn beautiful. He thus thinks that the arrangement of rocks from the avalanche compose a new object, namely an object that would make his front lawn beautiful.

Avalanche with accorded function and label
[*Avalanche (base)* plus] Even though avalanches are usually quite annoying for Jones, he decides at that moment that the rocks are actually strewn across his lawn in such a way that they will do perfectly for a beautiful rock garden. He thus thinks that the arrangement of rocks from the avalanche compose a new object, namely a rock garden.

Avalanche with designed function
[*Avalanche (base)* plus] Even though avalanches are usually quite annoying for Jones, he decides that in the morning he'll use them to make his front lawn beautiful.

The next day, he arranges all of the rocks in such a way that he thinks he has created something that makes his front lawn beautiful. He thus thinks that the arrangement of rocks compose a new object, namely an object that makes his front lawn beautiful.

Avalanche with designed function and label
[*Avalanche (base)* plus] Even though avalanches are usually quite annoying for Jones, he decides that in the morning he'll use them to make a rock garden.

The next day, he arranges all of the rocks in such a way that he thinks he has created a rock garden. He thus thinks that the arrangement of rocks compose a new object, namely a rock garden.

Our results on these six cases confirmed and extended our previous results. We continued to find a strong influence of function on judgments about composition, and we found no effect of naming and no interaction between naming and function. We also found a small but significant difference between accorded function and designed function, as may overall be visualized in:[14]
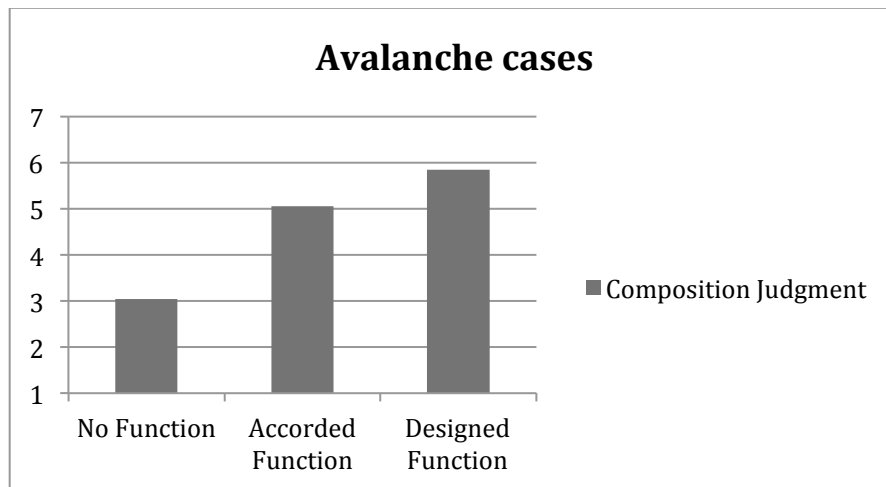
Avalanche cases

Thus with the Avalanche cases we see a continuation of the underlying pattern of teleologically driven intuitions, extended even to cases with scattered rocks. And we start to see inside this pattern, by seeing that merely according a function is already sufficient to flip intuitions, but that having the thing

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[14] 173 participants were recruited from Amazon's Mechanical Turk, and randomly assigned to one of six conditions. After reading the case participants were asked to indicated their agreement, on a 7-point scale (anchored with 1=completely disagree and 7=completely agree), with the following statement: "Rather than being a bunch of scattered objects that do not in any way compose some one thing, the arrangement of rocks actually compose something." Participants were then given, on a separate page, two comprehension questions:
1. Jones lives on the side of a mountain (yes/no)
2. Because of the avalanche, rocks were strewn across Jones' lawn (yes/no)

Four people were excluded from the data analysis for failing at least one of the control questions. Analyzing the remaining 169 responses using a two-way analysis of variance, we found a significant effect of function on people's composition judgments $F(1, 169)=46.341$, p=.000. Bonferonni post-hoc tests showed that composition judgments across each level of function were significantly different from the others: No Function Conditions (M=3.05, SD=1.34) were significantly different from both the Accorded Function (M=5.05, SD, 1.77, p<.001) and Designed Function Conditions (M=5.84, SD=1.52, p<.001) and the Accorded Function Conditions were significantly different from Designed Function Conditions (p=.011). There was no effect of Naming $F(1, 169)=2.185$, p=.141 nor was there an interaction between Naming and Function $F(2, 169)=.533$, p=.588.

designed all along to serve the function produces an even stronger effect. Putting this all together, we find strong support for the claim that the folk operate with something like the following (implicit) answer to the special composition question:

Teleologically Restricted Composition: Composition occurs when the plurality has a purpose.

We would emphasize that we are offering Teleologically Resricted Composition as an account of the folk theory, and not as a metaphysical claim. We would also emphasize the notion of a purpose involved is a folk notion (to be explored further in §3). So one should not say: "Clearly rocks have no real purpose; the folk think that there are rocks; so Teleologically Restricted Composition is false." Instead one should ask: "The folk think that there are rocks; but they also seem to think that Teleologically Restricted Composition is true; so can it be that the folk think that rocks have a *telos*?" (§4.3).

2.5 Restricted composition or restricted domain?
The Universalist who (like Lewis and Thomasson) thinks that her theory does not conflict with folk intuitions has at least one more trick up her sleeve. Instead of treating the folk as operating with anything like *Teleologically Restricted Composition*, she can treat the folk as operating with universal composition over a teleologically restricted domain, as per:

Teleologically Restricted Domain: In normal contexts, quantifiers are restricted to things that have a purpose

There is something to be said for this move, insofar as it will be vague whether something has a purpose, and insofar as *Teleologically Restricted Domain* relocates this vagueness from the metaphysics to the semantics (where vagueness most plausibly belongs). If this move could be shown to work, we would regard this as a very interesting result in its own right!

With this final trick in mind, we returned to our Handshake cases (§2.1) and had one of the characters (Andy) speak explicitly on behalf of the Universalist, saying the sort of things one might reasonably say to ensure that the domain of quantification is sufficiently open. This yielded:

Handshake without restrictions
Sally and Tom are leaders of rival political factions, and have recently decided to lay aside their differences. They have worked out all the details, signed all the official papers, and will now seal their deal with a public and historic handshake.

Later that day, Andy and Liz—who were both present for the historic handshake—have a disagreement over whether Sally and Tom created a new object when they shook hands.

Andy says that Sally and Tom did compose a single object. Indeed, he says that Sally and Tom always made a single, larger object, not just during the handshake, but before and after too. He says that in addition to the two people, Sally and Tom, there is, was, and will also be this larger object made of the two of them together. He says, "This larger object, which I will call 'the Sally-Tom hybrid' has two parts: a Sally part, and a Tom part. It weighs just as much as Sally and Tom put together. Before the handshake, its two parts were scattered, during the handshake its two parts that came into contact briefly, and after the handshake its two parts scattered. I know that we have no usual name for this larger object, and I know that it is not the sort of thing we usually chat about, but it is there all the same."

Liz, however, disagrees. She says that, both before Sally and Tom shook hands, during their handshake, and after, there were just two people present. There was never any third, larger object

made from Sally and Tom together, either before, during, or after the handshake. She clarifies: "There is no such thing of any sort as your alleged 'Sally-Tom hybrid.' It's not just that we don't usually chat about this thing. There is no such thing."

Despite Andy's explicit description of the sort of fusion he has in mind, and despite his explicit moves to open up the quantifiers, our participants still tended to agree with Liz (M=1.88, SD=1.48)[15] that "It's not just that we don't usually chat about this thing. There is no such thing."

Accordingly we see little prospect in sustaining Lewis's idea that our hesitation to accept the existence of arbitrary sums is merely due to contextual domain restrictions, and little prospect in sustaining Thomasson's (2007: 184) speculation that if "we explained to 'normal' people" a term for some arbitrary sum, and then asked them if there is such a thing, they "would certainly accept that there is." Instead we find empirical substantiation for Korman's (2008) skepticism that folk intuitions can be explained by Universalism plus domain restrictions. Of course it is possible that—despite Andy's explicit description of the sort of sum he has in mind, and his explicit moves to open up the quantifiers—he still failed to open up the quantifiers sufficiently. But pending real evidence for this it must be considered doubtful. Indeed we will provide buttressing psychological evidence from the theory of object categorization for the view that we are natural teleologists (§4). It's not just that we usually choose to focus on things with a purpose; it's rather that we naturally equate *being a thing* with *having a purpose*.

3. Inside Folk Teleology

So far we have documented a range of studies—our Handshake, Gollywag, Mouse, and Avalanche cases—which all converge on the conclusion that the folk judgments fit a teleological theory of composition. We have also started to get a bit more precise about the folk notion of "having a purpose," by seeing (§2.4) that being accorded a function after the fact matters, but actually being designed from the start to serve a function matters even more. We want to continue our preliminary exploration of the folk notion of purpose.

There are a range of distinctions we also want to explore, beyond the distinction between accorded function and designed function. These include whether the thing can in fact successfully perform the function it was accorded or designed for (or whether it in fact fails to serve the function), and what happens in cases where a thing takes in multiple functions (perhaps it was designed to serve one function, but is then accorded another), as well as interactions between these factors. In §§3.1-3.3 we explore these distinctions within the folk notion of purpose.

We should emphasize that the folk do seem to have an interesting notion of function, whose contours we are exploring. The folk do not seem to have the extreme view that every arbitrary collection serves a function, or the extreme view that no collection serves a function (otherwise they would speak

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[15] A total of 33 participants were recruited through Amazon's Mechanical Turk. After reading the case and indicating who they agreed with (Liz or Andy: again, using the same 7-point scale as in Handshake above), participants were then taken to a separate page where they answered three comprehension questions:
1. Sally and Tom are leaders of rival political factions (yes/no)
2. Andy thinks that the handshake did not create a larger object (yes/no)
3. Liz thinks that the handshake did create a larger object (yes/no)

Four participants were excluded for missing one or more comprehension questions which left a total of 29 responses.

like Universalists, or like Nihilists).[16] Nor of course can the folk be assumed to have a notion of function that fits what science has discovered about our world.

3.1 Rope cases
One aspect of the folk notion of purpose we wanted to explore a bit further was the extent to which success matters. Suppose that something fails to serve the purpose it was designed for. Does that thing still count as having a purpose (in the sense relevant to folk mereology), or not?

So we sought to compare a case with a failed design and a case with a successful design:

Ropes failure
Jones has an old, rusty water heater lying in his backyard. He thinks the water heater is ugly and so decides to move it out of his yard. So he ties a piece of rope around the water heater and pulls on it. But it does not move at all. Jones then thinks to himself, "The rope must be too short. I need something longer to get more leverage." He thus grabs another piece of rope and ties it in a knot around the other piece of rope that is already around the water heater. Jones then pulls on it but still the water heater does not move at all.

Ropes success
Jones has an old, rusty water heater lying in his backyard. He thinks the water heater is ugly and so decides to move it out of his yard. So he ties a piece of rope around the water heater and pulls on it. But it does not move at all. Jones then thinks to himself, "The rope must be too short. I need something longer to get more leverage." He thus grabs another piece of rope and ties it in a knot around the other piece of rope that is already around the water heater. Jones then pulls on it and is easily able to drag the water heater out of his yard.

We asked people whether they thought that Jones "created a single, unified object" or whether "When Jones tied the pieces of rope together, he did not create a single, unified object out of the rope. Rather, he simply had two, distinct pieces of rope."

We found that success matters to people's intuitions. In *Ropes failure* only 36% of our participants chose the option of "a single, unified object," while in *Ropes success* 63% of our participants chose the option of "a single, unified object." Graphically:[17]

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[16] Indeed Rea (1998) provides an argument for Universalism, based on the idea that every arbitrary collection serves a function. Whatever exactly the folk notion of function may be, we take it that it is much more restrictive than Rea's conception.

[17] 75 participants were recruited from Amazon's Mechanical Turk, and randomly assigned to one of two conditions. After reading the case, participants were given two response options:
   a. When Jones tied the pieces of rope together, he created a single, unified object out of the rope
   b. When Jones tied the pieces of rope together, he did not create a single, unified object out of the rope. Rather, he simply had two, distinct pieces of rope

After answering, they were then asked, on a separate page, two comprehension questions:
   1. Jones was trying to move a water heater (yes/no)
   2. Jones was able to move the water heater (yes/no)

Seven people were excluded from the data analysis for failing at least one of the control questions. Analyzing the remaining 68 responses, we found that whether or not the rope successfully fulfilled its function had an effect on whether people said that the rope was a single, unified rope or two separate pieces of rope $X2(68)=4.769$, $p=.029$.

Rope cases

Single, Unified Object
Two Separate Objects

Moved Water Tank
Did Not Move Water Tank
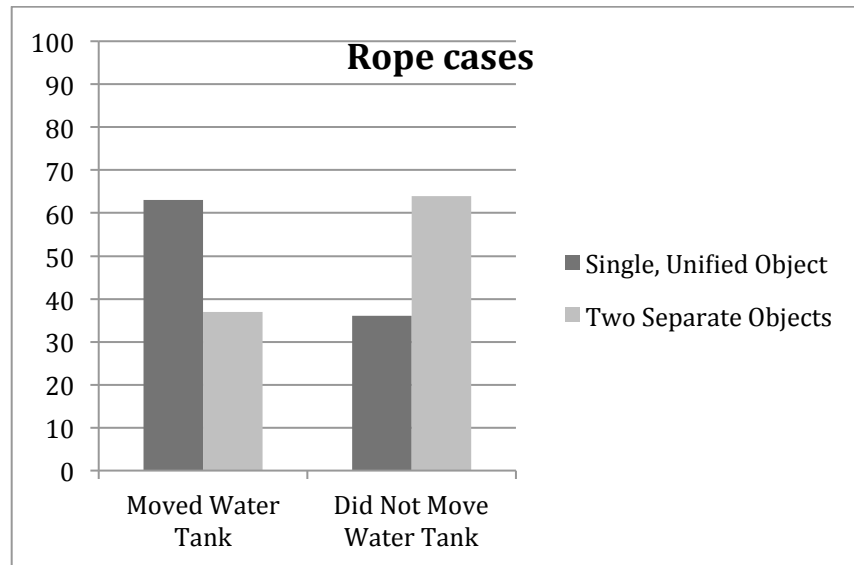
Comparing these results with our earlier results on Avalanche cases (§2.4), we can contrast two different dimensions along which a thing might be said to have a purpose (in the sense relevant to folk mereology). First, the thing might be originally designed to serve a given function, or it might merely be accorded a function after the fact. Secondly, the thing might succeed in serving whatever function it was either designed for or accorded, or it might fail to serve this function. So far it seems (from the Avalanche cases) that accordance versus design is not crucial for serving a purpose, though design seems to help bolster intuitions somewhat. But success tends to be required.[18]

3.2 Rock garden cases
We wanted to look further into the distinction between according something a function after the fact, and designing something with a function. In the Avalanche cases (§2.4) we saw that designed function played a stronger role than accorded function in influencing intuitions of composition. So we wondered whether intuitions triggered by accorded function were robust, and could survive explicit discussion of the idea that the thing was not in fact designed to serve that function. That is, we wondered whether designed function (or lack thereof) *trumped* accorded function when both were made explicit. We also wanted to continue looking at intuitions in the context of a scattered plurality.

So we returned to our Avalanche cases, again comparing cases in which the scattered plurality of rocks is just accorded the function of being a rock garden, with cases in which the scattered plurality of rocks is designed in advance to be a rock garden. But we also introduced a new character, Smith, whom we used to explicitly voice the lack of a designed function. We thus ran the following two cases:

> <u>Rock garden with accorded function</u>
> Jones was taking a walk in the forest one day. After walking for several hours, he came upon a field. In the field he found a bunch of rocks of all different shapes and sizes. Though nobody had ever encountered this before, Jones decided that the rocks were not merely a bunch of scattered objects but that they actually composed a new object: a rock garden.

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[18] When we say that success tends to be required, we mean to remain neutral on whether the thing in question might survive a later failure to serve its function. Contrast (i) a botched watch that never worked, with (ii) a broken watch that initially worked but later broke. We suspect that most people would deny that the botched watch is really a watch (it's just a collection of cogs and gears that doesn't really do anything), but may well uphold that the broken watch is still a watch (especially if it can easily be fixed so as to resume its successful performance).

Later that day, Jones was discussing the rocks that he discovered with his neighbor Smith. Jones told Smith that even though nobody has ever encountered the rocks before, he thought that the rocks composed a new object, a rock garden.

Smith, however, disagreed. He claimed that since the rocks were not out there for the purposes of creating a new object—a rock garden—the arrangement of rocks did not make a new object. Thus Smith claimed that the arrangement of rocks did not compose a new object, namely a rock garden.

Rock garden with designed function
Jones was taking a walk in the forest one day. After walking for several hours, he came upon a field. In the field he found a bunch of rocks of all different shapes and sizes. Though nobody had ever encountered this before, Jones decided that he wanted to make a rock garden. So he rearranged the rocks in such a way that he thought the new arrangement of rocks composed a new object: a rock garden.

Later that day, Jones was discussing the rocks that he discovered with his neighbor Smith. Jones told Smith that he took the rocks, rearranged them, and thereby composed a new object, a rock garden.

Smith, however, disagreed. He claimed that simply rearranging a bunch of rocks with the purpose of creating a new object—a rock garden—was not enough to actually make a new object. Thus Smith claimed that the rearrangement of rocks did not compose a new object, namely a rock garden.
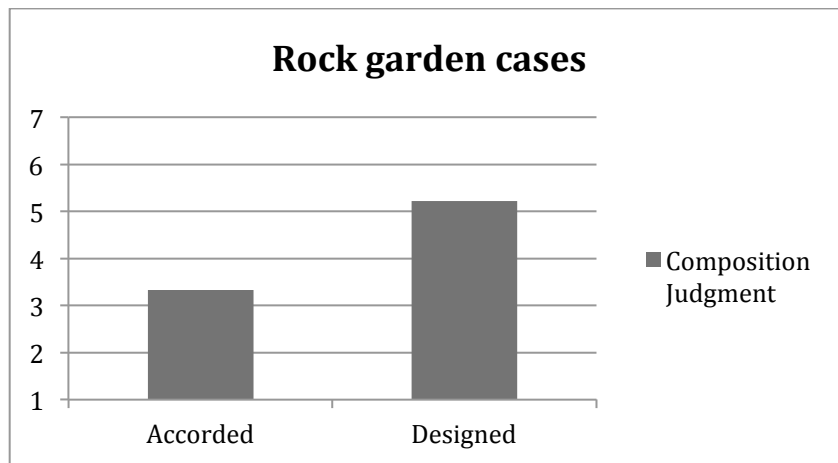
In *Rock garden with accorded function*, Jones accords the function of being a rock garden to a scattered plurality of rocks and Smith challenges Jones, claiming that the arrangement of rocks does not compose a rock garden since they were *not designed* with the purpose of being a rock garden. If designed function takes priority over accorded function, then we should expect that participants in this case will largely deny that the arrangement of rocks composes a rock garden. In contrast, in *Rock garden with designed function*, Jones arranges the rocks with the purpose of designing a rock garden, but Smith claims that arranging the rocks with the purpose of creating a rock garden was not enough to actually make a rock garden. If designed function plays a crucial role in composition intuitions, then we should expect that even in the face of Smith's downplaying the importance of designed function, designed function will still continue to guide composition judgments in this case.

We found that in *Rock garden with accorded function* our participants tended to agree with Smith's claim that the rocks did not compose a new object (M=3.33, SD=2.08), while in *Rock garden with designed function* our participants tended to agree with Jones's claim that the rocks did compose a new object (M=5.22, SD=1.78). This can be seen via:[19]

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[19] 68 participants were recruited through Amazon's Mechanical Turk, and randomly assigned to one of two conditions. After reading the case and indicating who they agreed with, participants were then given, on a separate page, two comprehension questions:
1. Jones and Smith were talking about what is required to create a new thing (yes/no)
2. Smith said that the rocks did not compose a rock garden (yes/no)

Seven people missed one or more comprehension questions. Analyzing the remaining 61 responses using a one-way analysis of variance, we found a significant effect of accorded versus designed function on people's composition judgments $F_{(1, 61)}=14.506$, $p<.001$, with people being more willing to say that the arrangement of rocks composed a rock garden in *Rock garden with designed function*.

Rock garden cases

[Bar chart showing two bars. Y-axis ranges from 1 to 7. "Accorded" bar reaches approximately 3.3, "Designed" bar reaches approximately 5.2. Legend: ■ Composition Judgment]

We saw in *Avalanche with accorded function* and *Avalanche with designed function* (§2.4) that both accorded and designed function played an important role in people's composition judgments, though designed function appeared to play a more significant role. In *Rock garden with accorded function* we saw that when designed function is emphasized, accorded function ceases to guide composition judgments. But even when designed function is downplayed in *Rock garden with designed function*, designed function still continues to guide people's judgments. Thus it seems that intuitions triggered by accorded function are not robust. Designed function (or lack thereof) trumps accorded function when both are made explicit. Putting our results in Rope cases and Rock cases together, we see that designed function tends to trump accorded function, and that success tends to be required.

3.3 Umbrella cases
In a final series of studies, we wanted to explore the interaction between accorded versus designed function, and success versus failure. We also wanted to elicit judgments of function from our participants so that we could have some direct measures of function, and also see how judgments of function (what something is for) would align with categorization judgments (what something is).

So we used stories about things that were originally designed to serve one function but were then later accorded a distinct function, varying whether or not the thing succeeded in serving the purpose it was originally designed for. Our first pair of cases involved a thing that was originally designed to be an umbrella, but later re-purposed as a lampshade:

Bad umbrella good lampshade
In the early 1400s people typically stayed indoors when it rained since they had nothing that would protect them from the rain. One day Jones decided that he would make something that could protect people from the rain. So, he took a piece of material, some screws and wood, and put them all together. He called it an "umbrella." To Jones' surprise, it did a terrible job at protecting people from rain: they still got just as wet as they would have if they did not use anything at all.

Four hundred years later, electricity was invented. Some people had lights in their house. But they were very bright since there was nothing to dim them.

Smith lived in the same house that Jones did over four hundred years ago. One day Smith was rummaging around in his attic and stumbled across one of Jones' old boxes. On the box was the label "umbrellas." Smith opened up the box and took out one of the objects. He then took it and

placed it over his lamp. He called it a "lampshade." To Smith's surprise, it worked perfectly for dimming the lights: when placed over a light, it was dimmed to just the right level of luminance.

One afternoon, Smith and Frank were having a disagreement. Frank claimed that the object was not a lampshade. Rather, he claimed that it was an umbrella. Smith, however, disagreed. He claimed that the object was a lampshade and not an umbrella.

In *Bad umbrella bad lampshade* we find an object designed to be an umbrella but bad at it, and yet very good at serving the unexpected purpose of being a lampshade. We wanted to contrast this with a case in which the object did succeed as an umbrella:

Good umbrella good lampshade

In the early 1400s people typically stayed indoors when it rained since they had nothing that would protect them from the rain. One day Jones decided that he would make something that could protect people from the rain. So, he took a piece of material, some screws and wood, and put them all together. He called it an "umbrella." To Jones' surprise, it worked perfectly at protecting people from rain: when outside in the rain, they stayed completely dry.

Four hundred years later, electricity was invented. Some people had lights in their house. But they were very bright since there was nothing to dim them.

Smith lived in the same house that Jones did over four hundred years ago. One day Smith was rummaging around in his attic and stumbled across one of Jones' old boxes. On the box was the label "umbrellas." Smith opened up the box and took out one of the objects. He then took it and placed it over his lamp. He called it a "lampshade." To Smith's surprise, it worked perfectly for dimming the lights: when placed over a light, it was dimmed to just the right level of luminance.

One afternoon, Smith and Frank were having a disagreement. Frank claimed that the object was not a lampshade. Rather, he claimed that it was an umbrella. Smith, however, disagreed. He claimed that the object was a lampshade and not an umbrella.

We found that intuitions flipped—in a connected way—both on the question of what the arrangement of material, wood, and screws composes (umbrella or lampshade), and on the question of what the object is for (protecting people from rain or dimming light). In *Bad umbrella good lampshade*, 68% of our participants said both that the object was a lampshade and that its function was to dim light, while in *Good umbrella good lampshade,* 73% said both that the object was an umbrella and that its function was to protect people from rain. Visually:[20]
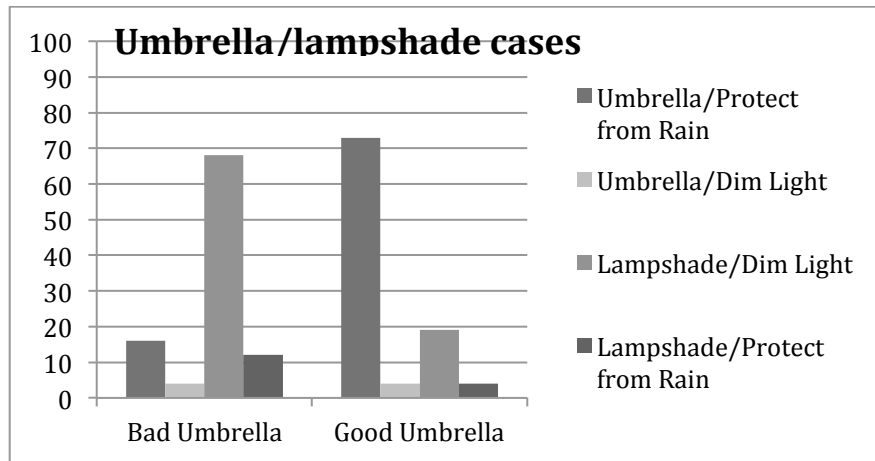
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[20] 57 participants were recruited through Amazon's Mechanical Turk, and randomly assigned to one of two conditions. After reading the case, participants were then presented with two questions (which were randomized):
1. The arrangement of material, screws and wood composes a: (lampshade/umbrella)
2. What is the object made of material, wood and screws for? (dimming light/protecting people from rain)
After answering these questions, participants were then taken to a separate page and presented with two comprehension questions:
1. Smith thought the object was a lampshade (yes/no)
2. Frank thought the object was an umbrella (yes/no)
Six people missed one or more comprehension questions. We analyzed the remaining 51 responses and found an effect of condition on both composition and function judgments (*Bad umbrella good lampshade*, X^2=8.383, p=.004; *Good umbrella good lampshade*, X^2=15.954, p<.001).

Umbrella/lampshade cases

100
90
80
70
60
50
40
30
20
10
0

Bad Umbrella   Good Umbrella

■ Umbrella/Protect from Rain
■ Umbrella/Dim Light
■ Lampshade/Dim Light
■ Lampshade/Protect from Rain

It seems that both designed function and success are playing a role in our connected intuitions about what a thing is and what a thing is for. Accorded function plus success seems to override designed function when they pull apart in *Bad umbrella good lampshade*. Yet designed function seems to be playing at least a tie-breaker role in *Good umbrella good lampshade*: when the thing has multiple successful functions, people attribute to it the function it was designed to produce over the function it was later accorded.

To extend this basic finding we considered two final variant cases, this time looking at cases in which the unintended function was not even for human beings but for an unfamiliar sort of organism ("togs"). These cases were:

Bad umbrella good tog-helper
In the early 1400s people typically stayed indoors when it rained since they had nothing that would protect them from the rain. One day Jones decided that he would make something that could protect people from the rain. So, he took a piece of material, some screws and wood, and put them all together. He called it an "umbrella." To Jones' surprise, it did a terrible job at protecting people from rain: they still got just as wet as they would have if they did not use anything at all. Jones was so frustrated that he just threw the object in his backyard.

In those days, a rare and dying species of animal—togs—had incredible difficulty catching prey. Togs were very small creatures that were almost completely blind. To hunt, togs had to completely rely on their ability to track sounds. But, unlike bats, togs were terrible at hearing sounds as they echoed off of objects. The object the Jones threw in his backyard, however, was perfect for echoing sounds at a frequency that only togs could hear. Since the object relayed the perfect frequency of sound for togs and no other creature could register the frequency of sound, togs were able to both hunt down prey and avoid danger with incredible efficiency.

One afternoon, Smith and Frank were having a disagreement. Frank claimed that the object was not an umbrella at all. Rather he claimed that it was a "tog echolocation device." Smith, however, disagreed. He claimed that the object was an umbrella and not a tog echolocation device at all.
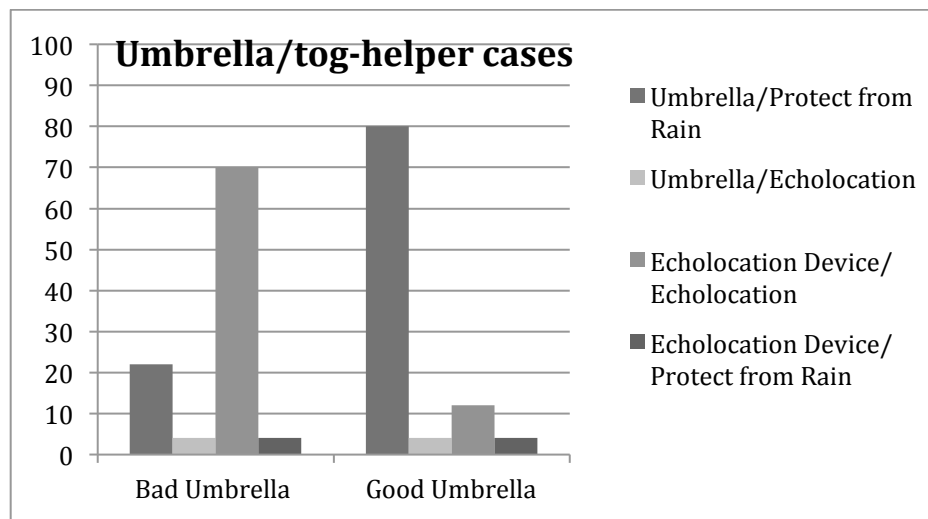
Good umbrella good tog-helper
In the early 1400s people typically stayed indoors when it rained since they had nothing that would protect them from the rain. One day Jones decided that he would make something that could protect people from the rain. So, he took a piece of material, some screws and wood, and put them all together. He called it an "umbrella." To Jones' surprise, it worked perfectly at

protecting people from rain: when outside in the rain, they stayed completely dry. Jones was so excited that he accidentally left the object in his backyard.

In those days, a rare and dying species of animal—togs—had incredible difficulty catching prey. Togs were very small creatures that were almost completely blind. To hunt, togs had to completely rely on their ability to track sounds. But, unlike bats, togs were terrible at hearing sounds as they echoed off of objects. The object the Jones threw in his backyard, however, was perfect for echoing sounds at a frequency that only togs could hear. Since the object relayed the perfect frequency of sound for togs and no other creature could register the frequency of sound, togs were able to both hunt down prey and avoid danger with incredible efficiency.

One afternoon, Smith and Frank were having a disagreement. Frank claimed that the object was not an umbrella at all. Rather he claimed that it was a "tog echolocation device." Smith, however, disagreed. He claimed that the object was an umbrella and not a tog echolocation device at all.

We found the same connection between intuitions of what a thing is, and intuitions of what it is for. And we found the same pattern of interaction between designed function and success. That is, in *Bad umbrella good tog helper* our participants (70%) tended to say both that the object was a tog echolocation device, and that it was for echolocation. While in *Good umbrella good tog helper* our participants (80%) tended to say both that the object was an umbrella, and that it was for protecting people from the rain. In an image:[21]

Together our Rope, Rock, and Umbrella cases suggest a fairly complicated interaction between accorded versus designed function, and success versus failure. When something is both designed to serve a certain purpose and succeeds at that purpose, then it seems that people will tend to lock onto that purpose in saying what a thing is as well as what it is for. But when the thing is accorded a different purpose after the fact, and only succeeds at that accorded purpose, then it seems that people may lock onto that accorded purpose in saying what a thing is as well as what it is for, at least so long as the lack of a (successful) designed function is not sufficiently emphasized.

But for the purposes of continuing to confirm that folk mereology is teleologically restricted, the point we would emphasize is how closely object categorization judgments (what the thing is) and function judgments (what the thing is for) are connected. It is natural to think of teleologically driven folk mereology as something of the limit case of our conceptual equation of what a thing is and what it is for. When the plurality is *for something* then it *is something*. But when the plurality lacks a purpose—when it is *for nothing*—then it *is nothing*.

4. Psychological context

Though we know of no psychological work that specifically considers the special composition question, there is of course a rich body of psychological work surrounding our object concepts. An account of folk mereology needs not only to fit the specific empirical evidence that we have offered, but it needs to cohere more generally with what we know about how we think. So we turn to situating our teleological view within the rich body of psychological work on object concepts, the folk notion of function, and the ways in which we tend to teleological conceptions of nature. The folk worldview is highly teleological. This is a perspective (on the world) one finds in Aristotle, and a perspective (on the folk) sustained in current psychology. As Dawkins (1995: 96) observes: "We humans have purpose on the brain. We find it hard to look at anything without wondering what it is 'for,' what the motive for it is, or the purpose behind it."

In §4.1 we trace the Aristotelian roots of a teleological conception of composition. In §§4.2-4.3 we connect to the contemporary psychological discussion on "promiscuous teleology" in both the child and adult worldviews. Finally in §4.4 we suggest that our explorations of the folk notion of purpose (§3) might contribute to the psychological discussion.

4.1 Aristotelian roots

Before turning to current psychological work, we digress briefly to suggest that our view—though absent from the contemporary discussion—has some Aristotelian roots. It is probably impossible to say anything about Aristotle without incurring scholarly controversy. Accordingly, we do not claim that our view matches Aristotle's full and considered view, but only mean to say that one can find elements of a teleological view in Aristotle, and that our view thereby counts as having Aristotelian roots.[22] We mainly mean to credit Aristotle for being onto an intuitive (albeit pre-scientific) conception.

Basically, we take Aristotle to hold a hylomorphic account of substances, with the substantial form playing the role of unifying the parts of a composite substance. And we take the substantial form to unify the parts of a composite substance by giving them a unified purpose: they become one because they act for the sake of a common end. This is the perspective that Aristotle seems to take when defending natural teleology in *Physics* (Aristotle 1984a: 340; *Phys*199a.30-33), saying: "[S]ince nature is twofold, the matter and the form, of which the latter is the end, and since all the rest is for the sake of the end, the form must be the cause in the sense of that for the sake of which." And this perspective is perhaps most explicit when Aristotle is explaining the many senses in which things are called one in *Metaphysics*, in the course of which he (1984b: 1605; *Meta*1016b.12-16) specifies the sense in which something is called one

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[22] For a scholarly and metaphysically informed discussion of Aristotle's view, see Koslicki (2008: ch. 6).

as "a whole," which he glosses in terms of having "one form," and illustrates with the example of the shoe: "[I]f we saw the parts of a shoe put together anyhow we should not call them one…; we do this only if they are put together so as to be a shoe and have thereby some one form."

We are not alone in finding a teleological account of composition in Aristotle. Indeed, we find Charles's (2001: 100) discussion of Aristotle on unity especially clear on this point:

> [I]t is the presence of a final cause which makes the relevant planks and bricks into a house. *Being a house*, on this view, cannot be reduced to being a mereological sum of bricks and planks. There is more to its unity than that of the sum of its components and their physical interrelations; for merely to specify these is to ignore the goal whose attainment is required if there is to be a house… Houses are the result of the operation of the final cause as a principle which organizes the relevant type of matter…

So we want to credit Aristotle with delivering an account that is, in virtue of its appeal to teleology, a good fit for folk metaphysics (even if that rules it out for real metaphysics).

4.2 Selective teleology: artifacts and organisms
Turning from Aristotle to contemporary psychology, a teleological approach claims support from leading psychological theories of artifact and organism concepts. It is widely accepted that we are at least "selectively teleological," in that our artifact and organism concepts are infused with notions of purpose and function. Most of the relevant psychological work concerns principles of *object categorization* (how we determine what a thing is). With both artifacts and organisms, we tend to identify what a thing is with what it is for.

There is a natural connection between object categorization and the special composition question, even beyond the fact that both involve object cognition (and for that reason alone might already be thought to follow common principles). For one can think of the special composition question as asking *whether a thing is* (that is, asking whether there is an individual y that fuses individuals x_1-x_n). And there is a natural connection between how we determine *what a thing is* (object categorization) and how we determine *whether a thing is* (folk mereology). Indeed, one can plausibly equate the question of whether a thing is with the question of whether there is anything that it is (that is, one can equate existence with falling under some category or other). When the plurality of individuals x_1-x_n collectively falls under an object category, then (and only then) should we be expected to say that the plurality has a fusion.

So starting with artifact concepts, as German & Johnson (2002: 279-80) note, it is well established that people take "the *design stance,* in which an entity's properties, behavior, and existence is explained in terms of its having been designed to serve a particular purpose." Likewise Bloom (1996: 3), reviewing earlier work by Rips and by Keil, notes: "This has suggested to many scholars that the psychological 'core' of artifact concepts is that their members share a common intended function."

With artifact concepts, there is a robust debate over the developmental details. For instance, Kelemen (1999a) argues that children take the design stance as early as four, Matan & Carey (2001) argue for a more complicated developmental process in which the design stance is not fully in place until six years of age, and German & Johnson (2002) argue for a different developmental process in which the ability to use an integrated adult-level design stance continues to develop in the period between five to seven years of age. We are only interested in the adult competence, which all sides agree is based on the design stance, and remain neutral on how and when this competence develops.

Turning to the organism concepts of "folk biology," it is well established that we strongly tend towards teleological thinking in this domain as well. For instance Keil (1995: 245) writes:

Historically there have been many arguments for a 'design' stance, which can include teleological interpretations and tool construction and use… Notions of functional architecture are among the most cognitively compelling ways of approaching the biological world and much of the artificial world as well, …

Likewise Atran (1998: 550-51) speaks of the folk idea of a "biological essence" as "an intrinsic… teleological agent, which physically… causes the biologically relevant parts and properties of a generic species to function and cohere 'for the sake of' the generic species itself."

Again there is robust debate concerning "folk biology," as to the extent to which biological cognition is domain-specific (perhaps subserved by a partially encapsulated "folk biology module") or an application of more general purpose cognition. And there is debate concerning the details of how we naturally organize the biological world hierarchically.[23] Again we remain neutral on these debates, maintaining only the minimal and uncontroversial claim that organism concepts are teleologically infused.

4.3 Promiscuous teleology
So far we have limited ourselves to object categorization with artifact and organism concepts, in accord with the approach that Kelemen (1999a: 243) calls "selective teleology" on which teleological thinking is largely restricted to these domains. But, as Kelemen (1999a: 244) argues, the more psychologically plausible view is that of "promiscuous teleology," according to which:

> [T]he teleological stance derives from children's understanding of agency and intentional object-directed behavior and may never become entirely autonomous from the intentional domain… [D]ue to these origins the teleological stance is applied broadly rather than selectively early in development: Infants may start out generally assuming that objects exist to be used by agents in some way and subsequently, in lieu of alternative explanations, develop the teleological belief that virtually all sorts of living and non-living entities are intentionally caused for a purpose. Children may only begin to revise and restrict this belief once they begin to assimilate more formal scientific ideas.

Indeed Kelemen (1999a: 245) goes on to note a historical tendency to view all of nature as an artifact:

> [T]hroughout history, non-living natural objects have also been considered in such [teleological] terms… The earth, its climates, landforms, water sources, and elements, were seen as intentionally designed to create a habitat for, and meet the needs of, people. In other words, natural objects of all kinds—particularly those fulfilling a significant function in people's lives—were candidates for construal as quasi-artifacts.

Indeed Kelemen & DiYanni (2005; c.f. Kelemen 2004) report a strong tendency among children—both from religious and nonreligious backgrounds—to an "intuitive theism" in which nature is viewed as an artifact of a creator, as well as a significant correlation between viewing something teleologically and regarding it as created. So one should expect teleological thinking to extend beyond artifact and organism concepts, to our general conception of an object.

We take the main unresolved issue concerning "promiscuous teleology" to be the extent to which it extends beyond children to adults. While children show a strong tendency to prefer teleological explanations to mechanistic explanations across the board, adults in contemporary Western cultures tend

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[23] See the response pieces to Atran 1998 for a useful overview of the main positions.

to resist teleological accounts when considering inanimate natural things like rock piles. For instance, Kelemen (1999b: 1443-44) asked both children and adults why a certain rock was pointy, and found that children tend to resist a mechanistic explanation in terms of bits of stuff being piled up, and instead prefer the following (bizarre) teleological explanation: "so that animals wouldn't sit on them and smash them." She found a strong preference for this style of teleological explanation among first and second graders, which persisted (albeit in diminished form) even among fourth graders, but was finally reversed with adults. Extending this research, Lombrozo & Carey (2006: 180) found that "adults accepted teleological explanations selectively," summarizing (2006: 184):

> We found that adults accept teleological explanations when two conditions obtain: (a) the function invoked in the explanation played a causal role in bringing about what is being explained and (b) the process by which the function played a causal role seems general, in the sense that it conforms to a predictable pattern.

That said, there is recent converging evidence that our childhood tendencies to teleological thinking persist (albeit in partially masked ways) through adulthood. Thus Lombrozo, Kelemen & Zaitchik—investigating the recurrence of teleological explanation in patients with Alzheimer's Disease—claim (2007: 999-1000) that "an underlying tendency to construe the world in terms of functions persists throughout life" and represents an "explanatory default." They (2007: 1004) conclude:

> [T]he preference for teleology is never outgrown. Rather, the preference persists throughout life, reemerging when causal beliefs that might otherwise constrain it are limited or compromised. In short, these findings provide evidence for a basic human preference to understand the world in terms of purpose. When faced with an object that supports a plausible function, humans make an immediate but defeasible inference to design, and assume a teleological explanation is warranted.

In a similar vein, Kelemen & Rosset—speeding up adults to prevent their background beliefs from intruding—elicited explicitly teleological judgments even in scientific contexts, concluding (2009: 143): "[T]he bottom line implied by the current findings remains that, like children, college-educated adults display scientifically unwarranted teleological explanations with ease." And perhaps the most interesting and recent results, due to Kelemen, Rottman & Seston (*forthcoming*: 6), involved research on an expert population of physical scientists, with the finding that: "even physical scientists, despite their extensive scientific training, routine adoption of physical-causal explanations, and anti-teleological norms, default to scientifically inaccurate teleological explanations when their cognitive resources are limited."[24]

Against this background of promiscuous teleological thinking even by adults, our hypothesis that folk mereology is teleological should be unsurprising. Our account thus coheres with a general plausible psychological picture of how we think, and deserves further credence on that basis. Given that we tend to associate what something is with what something is for, it should only be expected that we also associated *whether* something is with *whether* there is something it is for.[25]

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[24] It may be useful to invoke the image of a "dual processing system," on which the human mind is viewed as having both "Type 1" automated, encapsulated, and intuitive animalistic systems, as well as "Type 2" deliberative, general, and reflective systems layered over the Type 1 systems by evolution. Then we might say that teleological thinking is the product of Type 1 systems. To the extent that college-educated adults can sometimes avoid teleological thinking, it is only through the effortful employment of a trained Type 2 cognitive mechanism. In this vein Kelemen, Rottman & Seston (*forthcoming*: 2) characterize their view as "akin to dual-processing models that characterize early developing intuitions as heuristics that can be increasingly overridden later in development by effortful processing, but which can nevertheless persistently reemerge in cases when intuitions are favored or forced."

[25] Related to the special composition question is the special *de*composition question, which asks when an individual *y* has parts x_1-x_n. As Dan Korman (*personal communication*) suggested to us, our intuitions about decomposition

4.4 Insights for folk teleology

Our teleological account of folk mereology not only coheres with a plausible psychological picture of how we think overall, but our results may even shed further light on the general folk notion of function and its role in object categorization, and thus contribute to filling out the background psychological picture. So we hope to make some contribution to the discussion in psychology.

To begin with, there is wide agreement among cognitive scientists that object function is primarily determined by intended (/designed) function and that intended function largely guides object categorization judgments. For example, Rips (1989) found that adults judge that an object that looks like a lampshade is actually an umbrella when they are told that it was originally designed to protect people from rain. Matan & Carey (2001) and Hall (1995) found that adults judge category membership on the basis of original design despite the objects' being successfully used for some other purpose. And Kelemen (1999) gave children and adults cases where an object, either intentionally or accidentally, succeeds in fulfilling some other purpose and found that both children and adults tend to ignore successful use, favoring categorization judgments in line with original intended design. These findings cohere with our findings targeting composition judgments (§3), on which function is primarily determined by design plus success.

But these studies have almost exclusively focused on cases in which the designed function was also a success (the object worked as intended). Cases in which the object fails to work as intended have not really been explored. Our Umbrella cases (§3.3) begin the exploration. Our results confirm the "standard view" that designed function—when successful—runs the show. But our results also suggest the somewhat surprising coda that when the designed function fails there is then room for successful accorded function to enter the picture. This is not predicted on any existing story. Folk teleology may turn out more complicated than has hitherto been supposed. Our results thus not only cohere with but indeed further extend the psychological picture of our object concept as encrusted with teleological muck.

5. Methodological Implications

We began by documenting various answers to the special composition question and the charges of "mereological madness" that have played a major role in the metaphysical debate (§1). We then offered an empirically driven case for regarding folk mereology as teleological (§§2-4). We are now in position to address methodological issues about the role of folk intuitions in answering the special composition question, having achieved sufficient understanding of folk mereology to judge its credentials.

We situate this discussion within the dialectic surrounding "the expertise defense" against experimental philosophy, according to which the intuitions of the folk do not deserve serious credence. In §5.1 we advocate "the nuanced view" that the prospects for the expertise defense must be evaluated on a case-by-case basis in empirically disciplined ways. In §5.2 we then offer an empirical *vindication* of the expertise defense for the specific case of mereological intuitions. Finally in §5.3 we trace the methodological implications of our views on folk mereology for the metaphysical debate as to when composition occurs, concluding that answers to the special composition question should be liberated from any demand to fit folk intuitions.

5.1 The expertise defense and the nuanced view

With the rise of experimental philosophy has come a very general objection to the relevance of folk intuitions known as "the expertise defense." According to the expertise defense, folk intuitions are largely irrelevant to philosophical thought experiments because the folk are overly prone to error. They cannot be

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may also follow a teleological pattern. Thus we think of the human body as having hands, eyes, and lungs as parts, and tend not think of the human body as having arbitrary portions of forearms as parts.

counted on to understand the relevant concepts or draw the salient distinctions. One should only seriously consider the intuitions of the trained philosopher, with her considerable experience in analyzing concepts and drawing distinctions. Thus Hales (2006: 171) offers an analogy with the trained physicist: "the physical intuitions of professional scientists are much more trustworthy than those of undergraduates or random persons in a bus station," Ludwig (2007: 148-9) gives an analogy with the trained mathematician, and similarly Williamson (2007: 191), downplaying "verdicts by people without philosophical training," gives the analogy of the trained lawyer: "philosophy students have to learn how to apply general concepts to specific examples with careful attention to the relevant subtleties, just as law students have to learn how to analyze hypothetical cases."[26]

In response to the expertise defense (so understood), some experimental philosophers have questioned whether philosophers can lay claim to the mantle of expertise with thought experiments. Thus Weinberg (2007) charges that intuition is generally *hopeless* in that it is a fallible method without any means for detecting or correcting errors. And of course Hales's analogy with the physicist cuts both ways: if measured by training time, the philosopher looks more like the physicist; but if measured by theoretical progress, the philosopher looks more like the layperson (or at least not much like the physicist).

Moreover, it has been empirically demonstrated (through experimental work on philosophers themselves) that philosophers remain liable to many of the conceptual errors that afflict the folk. For instance, Hitchcock & Knobe (2009) found that normative considerations impacted causal judgment similarly for both those with and those without philosophical training, Schwitzgebel & Cushman (2012) found that order effects in trolley cases were similar for both those with and those without philosophical training, and Machery (2012: 50) found that intuitions about reference among different subgroups of

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[26] There are actually two different versions of the expertise defense that should be distinguished. The *expert-intuitions defense* distinguishes folk intuitions from expert intuitions, and says that only expert intuitions should be trusted. In contrast, the *expert-reports defense* distinguishes folk reports of folk intuitions from expert reports of folk intuitions, and says that only expert reports of folk intuitions should be trusted. The expert-reports defense allows that folk intuitions matter, but merely questions the ability of the folk to reliably express their intuitions.

In the main text we focus on the expert-intuitions defense because we think that the usual analogies with physicists etc. only fit the expert-intuitions defense. We should indeed trust expert physicist intuitions about acceleration over folk intuitions about acceleration (the physicists know better). But why on earth should we trust physicist reports of folk intuitions about acceleration? Indeed the expert-reports defense is empirically implausible on this very point. Expertise is known to come with the cost of losing track of how non-experts think ("the curse of expertise": §5.2). If an expert physicist bothers to report on folk intuitions about acceleration, she not only deserves no special credence on this topic, but in fact merits an extra pinch of skepticism.

That said, there may remain a concern—connected with the expert-reports defense—that our participants did not express their true intuitions but instead answered in some other way. In this vein, Bengson (2013: 504) challenges the claim that "Subjects' prompted answers express subjects' intuitions," suggesting (2013: 521) that prompted survey answers may just be "quick hypotheses, obliged guesses, hasty inferences, and hurried emotional reactions." (Though Bengson does not say how to tell when a prompted answer expresses a true intuition, or whether to believe that trained philosophers do any better at reporting their true intuitions.)

We agree that it is possible (as per Bengson's challenge) that our participants did not express their intuitions but instead gave some sort of blind answer. We regard this as one of the many potential empirical difficulties we warned of at the start of §2, and one which can only be properly addressed by empirical research. (Though we would add that the objector has the burden of proof. Otherwise we are left with a kind of blanket skepticism about survey methodology and other participant response methodology, which would call into question large portions of cognitive psychology.) In any case we think that, whether or not our participants' answers are to be glorified with the title of "intuition" (whatever exactly that adds), the interesting point remains that our participants are not all over the map (as we would expect if participants were just guessing) but in fact robustly tend towards a teleological viewpoint. The teleological viewpoint seems to be a cognitive default (§4.3), representing a robust, widespread, and persistent aspect of our cognitive system. We think that this is an interesting psychological phenomenon which should lead us to dismiss our initial take on when composition occurs.

experts (in philosophy of language and in linguistics) varied significantly in ways suggestive of biasing.[27] These results suggest overall that there may be nothing specially trustworthy about the intuitions of trained philosophers (c.f. Tobia, Buckwalter & Stich *forthcoming*). This should not be surprising. As Kahneman (1991: 144) summarizes the standard view in social psychology: "[T]here is much evidence that experts are not immune to the cognitive illusions that affect other people."

That said, the expertise defense only requires the weak claim that philosophers tend to do overall better than the folk in the specific domain of evaluating thought experiments (Williamson 2011: 218-219). It does not require the claim that the philosophers do any better than the folk beyond this domain, or that the philosophers entirely avoid the errors of the folk within this domain, or even that the philosophers are not prey to their own distinctive errors within this domain. And this weak claim remains at least *prima facie* plausible. Thus Weinberg *et al* (2010: 333) grant "a strong default standing" to this weak claim, acknowledging that: "It borders on the trivial to claim that philosophers' training makes them at least somewhat better than the folk, at least at some philosophically-relevant tasks."

We join Weinberg *et al* (2010) in regarding the existing discussion (on both sides) as having been *too crude*. On this view, which we will call "the nuanced view," the prospects for the expertise defense must be evaluated on a case-by-case basis, in empirically disciplined ways. Philosophers are indeed (presumptive) experts in evaluating thought experiments, but expertise is known to be a mixed blessing. Experts generally outperform laypersons in a wide variety of ways (though in many cases by surprisingly little: Tetlock 2005), but can also underperform in others. Experts enjoy certain specific cognitive benefits, but are also liable to specific sorts of biases and oversights of their own, including overconfidence in situations with low predictability (Griffin & Tversky 2002: 247).[28]

So for any given thought experiment on which the philosophers and the folk diverge, we need to know *why* the philosophers intuit as they do, and *why* the folk intuit as they do. Only then can we evaluate whether the divergence reflects a conceptual error of the untrained folk, or a cognitive bias of the expert philosopher. As Rose & Danks (*forthcoming*) observe, the expertise defense is thus best understood as "a call for more experimental philosophy."

Controversy remains over where the burden of proof lies when the philosophers and the folk diverge (c.f. Williamson 2011). Should the philosophers be treated as presumptively correct, or need their standing be positively established? We take no stand on who has the burden of proof. For in the case of intuitions about when composition occurs, we hope to have achieved sufficient understanding of why the folk intuitions are as they are (§§2-4) to move beyond "burden tennis." We claim an empirical substantiation of the expertise defense *for the specific case of mereological intuitions*.

5.2 The expertise defense against folk mereology
Given that the prospects for the expertise defense must be evaluated on a case-by-case basis in empirically disciplined ways (as per the nuanced view: §5.1), one should consider the prospects for the expertise defense for mereological intuitions. In this specific case there is an obvious respect in which *the expertise defense succeeds*. The folk are operating with muddled teleological notions, and the experts (the philosophers) seem to have corrected for this error, at least in their explicit theorizing.[29]

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[27] For a more comprehensive list of studies specifically on the intuitions of philosophers, see:
http://experimentalphilosophy.typepad.com/experimental_philosophy/2013/03/what-has-experimental-philosophy-discovered-about-expert-intuitions.html#more
[28] As Weinberg *et al* (2010: 340) nicely put the point: "[T]o have configural rules and higher-order concepts is at the same time to have another piece of cognitive machinery upon which priming effects and the like can get a hold."
[29] The reader may be surprised to see experimental philosophers siding with the expertise defense! But really we are siding with the nuanced view (which we get from Weinberg *et al* 2010) on which the expertise defense is just

Indeed with mereological intuitions we see a pattern that evinces both the promises and the perils of expertise. On the one hand, expertise confers the benefit of overcoming naïve folk theory. A characteristic feature of expertise is the development of improved theories for the domain. In this vein Kaiser, McCloskey & Proffitt (1986) found that naïve subjects—especially between 3rd and 6th grade— often incorrectly predicted that a ball emerging from a curved or spiraling tube would continue along a curving trajectory (undergoing curvilinear rather rectilinear motion), presumably due to a naïve folk physics of *impetus*. This error was observed to a significantly lesser degree with college students, presumably due to some level of physics training. Indeed with the specific matter of teleological explanation, the adult tendency away from teleological explanation (§4.3) in western cultures is probably due to formal scientific training. In this vein Casler & Kelemen (2008) compared formally schooled and unschooled groups of Romanian Romani adults from the same community, and found that the formally schooled adults were significantly less likely to advert to teleological explanation.

On the other hand, expertise comes at the cost of losing track of how the folk think. This is actually a consequence of the more general and well-established cognitive bias known as the "curse of knowledge" (Camerer, Loewenstein & Weber 1989), which occurs when a more knowledgeable subject incorrectly projects his or her knowledge onto a less knowledgeable subject. This bias is specifically known to apply to experts (c.f. Hinds (1999) on "the curse of expertise").

So one would predict that philosophers would be less prone to error when it comes to applying naïve teleology, and yet more prone to error when it comes to predicting the folk. This is the pattern we observe: philosophers do not themselves offer teleological theories of when composition occurs (§1.2), but they are also blinded to the prospect that the folk theory might be teleological (§1.3).

Accordingly we see a good *case-specific* reason to follow the philosophers over the folk when their intuitions about composition diverge. On this matter the folk intuitions are tied into a benighted teleological view of nature. For that reason it is the philosopher whose intuitions deserve more credence, as coming from a more enlightened perspective. (At the same time we equally see a good case-specific reason to ignore the philosophers when theorizing about what the folk think. On this matter it is the philosopher who suffers the curse of knowledge.)

Epistemically speaking, we want to say that any line of argument that is premised on folk intuitions about composition suffers from an *undermining defeater* (c.f. Pollock 1987). Just as the force of testimony is undermined if it is discovered that the testimony is based on a lunatic view on the topic, so the force of intuition is undermined it is discovered that the intuitions are based on a hopeless theory of the topic. (As is standard with defeaters, there can also be *reinstaters*. For instance it might be found that the lunatic views of the testifier happen by luck to agree with sane views in the case at hand. But any such reinstatement must be shown.)

In other words, we want to say that there is a *debunking explanation* for folk intuitions about when composition occurs.[30] Imagine that it is discovered that we intuit that something is alive when we think the thing has a spirit. Our intuitions about when something is alive would thereby be debunked, and should be accorded no weight in disputes about biological classification. Likewise if it is discovered that

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another empirical hypothesis about a given domain. Of course there are *some* domains (e.g. folk physics) in which the empirical evidence shows the folk to be confused. We take the empirical evidence to suggest that folk mereology is one of these domains.

[30] We follow Kahane (2011: 106) in associating undermining defeaters and debunking explanations: "Debunking arguments are arguments that show the causal origins of a belief to be an undermining defeater." See Mason (2010) for a useful overview of the structure of debunking arguments.

we intuit that some things fuse when we think they have a collective purpose, our intuitions would thereby be equally debunked, and would thereby equally deserve no weight in disputes about mereological composition. (As is standard with debunking explanation, there can be *restorers*. For instance it might be found that the "spirited" view of life is connected with a tendency to attribute being spirited on the basis of reliable indicators of life, such as self-movement. But any such restoration must be shown.)

There are of course difficult background issues about where to draw the line with debunking explanations. On the one hand, if we demand that our folk theories be *perfect* to be trusted, then we will be left with a blanket skepticism about intuitions. Perhaps such a skepticism is defensible; we only do not wish to premise our argument on such a radical view. On the other hand, if we allow that our folk theories be *terrible* and still trust them, then we are left with a naïve credulity about intuitions. Theorizing about this issue is obviously beyond the scope of the current discussion. But for present purposes our claim is that there are clear cases of undermining defeaters and debunking explanations (such as our hypothetical spiritual folk biology), and that teleological folk mereology is one such clear case.

5.3 The special composition question liberated
If we are right that folk mereology is teleological, what follows for the special composition question? That is, what if any morals should the metaphysician draw from our discussion? First and foremost, we hope to have made an empirically substantiated case that answers to the special composition question should not be beholden to folk intuitions. Accordingly we claim to have *liberated* the prescriptive metaphysician from the various charges of "mereological madness" in the literature. Whatever problems Universalism or Nihilism or any of the other extant views about composition might have, failure to fit folk intuitions is not among them. (Not because these views fit folk intuitions, but because folk intuitions in this domain are tied into a benighted teleological view of nature.)

Folk mereology looks to us in many ways akin to folk physics. Both involve fascinating conceptual machinery worthy of extended psychological study, but neither can make any serious claim to fitting reality. Objecting to a philosophical theory of mereology on grounds that it violates folk intuitions about composition looks to us roughly on par with objecting to Newtonian mechanics on grounds that it violates folk intuitions about persistent curvilinear motion. In both cases the theories do conflict with folk intuitions, but the folk intuitions deserve dismissal.[31]

We would conclude by considering three likely follow-up reactions to our claim that folk mereology is teleological.[32] One sort of follow-up reaction—which some people drawn to the crude general form of the expertise defense might be drawn to—involves revisiting the question (from §1) of whether the metaphysicians really meant to be appealing to folk intuitions or to something more like the expert intuitions of philosophers (c.f. Kauppinen 2007). We doubt that this question has a clear answer, and suspect that the matter is in many cases indeterminate. Philosophers who would invoke intuitions need to become more explicit. But if a metaphysician meant to be making a claim about the expert intuitions of philosophers, and claimed that there was any consensus in the expert intuitions (in any way

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[31] At this point we join Goldman (2007) and Paul (2010) in thinking that cognitive science can prove relevant to real metaphysics, if only to teach us which intuitions should be ignored. As Goldman (2007: 2) explains: "Cognitive organs or mechanisms play a critical role in the causal production of appearances, including metaphysical appearances (whatever exactly we take that to connote). In considering whether such metaphysical appearances should be accepted at face value or, alternatively, should be superseded through some sort of metaphysical reflection, it obviously makes sense to be as informed as possible about how these mechanisms of cognition work. That is why cognitive science is relevant."

[32] Our discussion of reactions is not supposed to be exhaustive. For instance, we will not consider the reaction of attempting to revive teleological thinking. See Hawthorne & Nolan (2006) for further discussion.

comparable to the way that there is a consensus in expert intuitions on Gettier cases), then her claim seems clearly false. While we do not have empirical evidence as to the distribution of views among philosophers, it certainly seems as if there is little agreement among the experts in this case, with intuitions swinging all the way from Universalism to Nihilism and stopping at many places between (§1.2). The folk may be benighted, but the experts seem divided.

A second sort of follow-up reaction—which some partisans in the metaphysical dispute might be drawn to—would be to appeal to "corrected" intuitions in a revised argument for mereological sanity. Perhaps if we could just wipe the teleological muck off from the folk theory we would find clean intuitions by which to judge theories. We are skeptical, in part because we can imagine different partisans in the metaphysical dispute spinning this move in different ways. We can imagine the Universalist saying: "The folk only ever reject composition when they think the result has no purpose; wipe off the teleological muck and the folk would no longer ever reject composition." But we can equally imagine the Nihilist saying: "The folk only ever accept composition when they think the result has a purpose; wipe off the teleological muck and the folk would no longer ever accept composition." And we can just as equally imagine partisans of various restrictive views saying: "The folk clearly hold a restricted theory and we should try to honor that commitment; wipe off the teleological muck and the folk would need a more respectable restriction." The folk concept can be cleaned up in many ways. We doubt there is a determinate fact as to what "the" corrected folk theory would look like.

A third sort of follow-up reaction—which some skeptics about prescriptive metaphysics might be drawn to—would be to say that the special composition question has been revealed to be hopeless, in that we lack the epistemic wherewithal to select the right answer.[33] As Rosen & Dorr (2002: 154-156) clarify, each proposal is analytically consistent, and all the proposals seem to be empirically equivalent. If intuitions cannot help either, what remains? Perhaps the skeptic is right. Though we think that there are still virtues of simplicity, elegance, and coherence with wider theory in play that may still help favor certain approaches. Overall we suspect that liberating the special composition question from folk intuitions helps tilt the overall balance somewhat in favor of the elegant but "radical" extreme views of Nihilism and Universalism, over the more complex but "conservative" intermediate positions. But this is a matter that obviously falls beyond the scope of the current discussion. We are defending a descriptive claim about when the folk think composition occurs (and tracing out its methodological implications). We are not defending any metaphysical claim about when composition in fact occurs, nor are we defending any metametaphysical claim about the overall prospects for metaphysical knowledge.

To summarize: Many metaphysicians have wanted a view of mereological composition that fits with folk intuitions, and have charged leading views with failing to do so, while failing themselves to agree as to what the folk intuit or why they do so. So we have tried to put the tools of experimental philosophy to constructive use to break this impasse. We have found something that, though unconsidered by any of the metaphysicians, coheres well with recent psychological work: the folk intuitions are based on a teleological conception of when composition occurs. The folk tend to say that composition occurs when the result has a purpose (more precisely: when the thing was designed to serve a purpose and succeeds at that purpose). And we have suggested, in conclusion, that this finding should lead us to liberate the metaphysics of composition from any demand of fitting with folk intuitions. Folk mereology is teleological, and hence unenlightened.[34]

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[33] See Bennett (2009) and Kriegel (*forthcoming*) for defenses of skeptical views on the composition debate. Both Bennett and Kriegel accept that there is a meaningful special composition question, and merely recommend withholding belief as to which is the right answer. Though of course there is also room for a skeptical view that denies that the special composition question is even meaningful.

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