

The Spatially Restricted Theory of Composition

by

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Abstract

Determining when some x s compose a y provides the answer to the Special Composition Question. There are three types of possible answers: always, sometimes, never. All of the competing views fall into one of these three categories. I present these competing theories, and explain the advantages and objections to each, and in the cases of those falling into the “always”, and “never” categories explain why the categories cannot provide a satisfactory response. Then I present my own answer to the Special Composition Question and show that it is not vulnerable to the objections the competitor theories cannot overcome. I also present a novel solution to the General Composition Question.

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Dedication

I dedicate this work to my loving and patient wife.

Glossary

Abstract Object. An object is abstract if it is not located in space or time (sets, universals, etc...). This is not uncontroversial, but is the condition I will be using to stipulate ‘abstract object’.

Antisymmetry. $\forall x \forall y [(Pxy \ \& \ Pyx) \rightarrow x = y]$, where P is the parthood relation. (Wasserman, 2009)

Atomic Model. A Model *M* of the theory is atomic if every *n*-tuple of elements of *M* satisfies a complete formula.

Brutal Composition. There is no true, non-trivial and finitely long answer to the special composition question.

Composite. *y* is composite iff there is an *x* and *z* such that *x* is a proper part of *y*, *z* is a proper part of *y* and $x \neq z$.

Composition Relation. The *x*s compose *y* iff the *x*s are all non-overlapping parts of *y* and every part of *y* overlaps at least one of the *x*s.

Concrete Object. An object is concrete if it is located in space and time (ordinary physical objects).

Contact Composition. Necessarily, for any nonoverlapping *x*s, there is an object composed of the *x*s iff the *x*s are in contact with one another.

Countable Set. A set is countable if it is finite, or there is a 1:1 correspondence between the set and the natural numbers. It is **uncountable** if it is infinite and there is no 1:1 correspondence with the natural numbers.

Duplicate. An object *a* is a duplicate of object *b* iff their parts may be put in one-one correspondence preserving the fundamental properties and relations.

Exdurance (Stage Theory). An object is identical with its temporal part at a given time and identical with a different temporal part at a different time.

Extended Simple. A material object extended in space (or space-time) that nonetheless lacks proper parts. (McDaniel, Extended Simples, 2005)

Extensionality. $\forall x \forall y [x = y \leftrightarrow \forall z (Pzx \leftrightarrow Pzy)]$, where P is the parthood relation. (Wasserman, 2009)

Fusion Relation. Something is a fusion of some things just in case they compose that thing. (Caplan, Tillman, & Reeder, 2010)

Gunk. A composite object where there are no atomic parts. Any part taken from a gunky object is itself gunky and also divisible.

Uniqueness of Composition. Whenever there are some x s that compose a y , there is at most one y that the x s compose. (Uniqueness of Composition)

Fastenation. Given any x s, the x s are fastened together if they are somehow stuck together.

Fastenation Composition. Necessarily, for any nonoverlapping x s, there is an object composed of the x s iff the x s are fastened together.

General Composition Question. What *is* composition?

Intrinsic Property. A property is intrinsic iff it can never differ between a pair of possible duplicates. (Stipulation)

Maximality Principle. There is a 1-1 map from the entire universe into the pure sets.

Mereology. The study of the relation of the parts to the whole.

Mereological Essentialism. If anything is ever a part of a whole, then it is a part of that whole as long as that whole exists. (Chisholm, 1973)

Mereological Nihilism. Given some x s, there is never a y such that the y is composed of the x s.

Mereological Simple. An object that has no proper parts.

Monism

Existence Monism. The view that there exists only one (non-abstract) object: the entire world.

Priority Monism. The view that exactly one basic concrete object exists – there may be many other concrete objects, but these only exist derivatively.

n-Fastenation. Necessarily, for any nonoverlapping x s, it is true to degree n that there is an object composed of the x s iff the x s are fastened together to degree n .

Overlap. x overlaps y iff there are an x , y , z such that z is a part of x and z is a part of y and at least two of x , y , and z are distinct

Perdurance (Worm Theory). A persisting object is composed of all the temporal parts that it has at different times. All persisting objects are four-dimensional ‘worms’ stretched out over space-time.

Proper Part. x is a proper part of y iff x is a part of y and x is not identical to y .

Reflexivity. $\forall x(Pxx)$, where P is the parthood relation. (Wasserman, 2009)

Regular Cardinal. A cardinal that is equal to its own cofinality. Roughly, a cardinal which cannot be broken into a collection of smaller parts.

Serial Response. The correct response to the Special Composition Question takes the form of a series.

Special Composition Question. What necessary and jointly sufficient conditions must any xs satisfy in order for it to be the case that there is an object composed of those xs?

Strongly Inaccessible Cardinal. A cardinal k is strongly inaccessible iff k is uncountable, regular and a strong limit cardinal.

Strong Limit Cardinal. A cardinal k is a strong limit cardinal iff, for every $\lambda < k$, $2^\lambda < k$.

Uniqueness of Composition. Whenever there are some xs that compose a y, there is at most one y that the xs compose.

Unrestricted Composition. Given some xs, there is always a y such that the y is composed of the xs.

Van Inwagen's Life Proposal (VLP). Necessarily, for any nonoverlapping xs, there is an object composed of those xs iff (i.) the activity of the xs constitute a life or, (ii.) there is only one of the xs.

Weak Fastenation. Necessarily, for any nonoverlapping xs, there is an object composed of the xs iff the xs are fastened together to some degree greater than zero.

Weak Fastenation with Degrees. (i) Necessarily, for any nonoverlapping xs, there is an object composed of the xs iff the xs are fastened together to some degree greater than zero. (ii) Necessarily for any nonoverlapping xs fastened together to some degree greater than zero and for any x among those xs, x is a part of the object composed of the xs to the degree to which x is fastened to the rest of the xs.

Chapter 1 - Introduction

Mereology is the study of the part – whole relation. The field is intriguing as some commonly held beliefs about composite objects are incompatible. These beliefs regard plausible claims about composite objects, and yet are collectively incompatible. Of even greater concern, several problems of material constitution¹ arise. In this thesis I present these problems of material constitution that arise from incompatible beliefs about composite objects, critique the current responses to these problems, present and defend a novel reply to these problems.

There are two important questions for which we seek an answer:

1. What is composition?
2. What are the necessary and jointly sufficient conditions for some x s to compose a y ?

The first question is The General Composition Question (GCQ) (van Inwagen, *When Are Objects Parts?*, 1987) and the second is The Special Composition Question (SCQ). (van Inwagen, *Material Beings*, 1990) The answer to the general composition question must explain what composition is. This is a question about the relationship between the whole and the objects which jointly compose that whole. Van Inwagen sets a high standard for answers to this question, requiring “a sentence containing no mereological terms that [is] necessarily extensionally equivalent to ‘the x s compose y ’” (van Inwagen, *Material Beings*, 1990). This is such a high standard that

¹ These problems include the well-known The Problem of the Arbitrariness of Undetached Parts, The Ship of Theseus Puzzle, The Puzzle of the Statue and the Clay and The Problem of the Many.

almost everyone has followed van Inwagen's lead -- "I am inclined to think there is no way of answering the General Composition Question." (van Inwagen, *Material Beings*, 1990) -- And focused their efforts on providing an answer to the Special Composition Question. There are numerous potential benefits to attempting to solve this problem. Partial solutions even could be "illuminating and non-trivial" (Hawley, 2006) and even provide evidence for other fields of study. We may find, as an example, that composition is fundamentally a different process for concrete objects than composition for abstract objects. There may be implications for persistence, philosophy of art, or the possibility of time travel. The benefits of study definitely warrant further review of this subject even if there is little hope of finding a solution that meets van Inwagen's high standards.

The answer to the special composition question must provide the necessary and jointly sufficient conditions under which some x s compose a y . Van Inwagen requires that answers to the special composition question form "a sentence which contains no mereological terms, in which no variable but 'the x s' are free and which is necessarily extensionally equivalent to ' $\exists y$ the x s compose y .'" (van Inwagen, *Material Beings*, 1990) These answers fall into three categories:

1. Given some objects x_1, x_2, \dots, x_n , these x s always compose a y ,
2. Given some objects x_1, x_2, \dots, x_n , these x s sometimes, but not always compose a y , and
3. Given some objects x_1, x_2, \dots, x_n , these x s never compose a y .

The ‘always’ category is commonly called ‘Universalism’, or ‘Unrestricted Mereological Composition’. The nihilist’s response, the third of the three categories, is that nothing is ever a proper part of anything else. The nihilist contends that composition does not occur. Philosophers who have held this view include Peter Unger (Unger, *The Problem of the Many*, 1980) and Cian Dorr. (Dorr, *Composition as a Fiction*, 2002). There is second group of philosophers who have presented theories that conform to what Sider calls “semi-nihilism”. (Sider, *Against Parthood*, 2010) This second group contends that composition does occur, but that only objects of certain kinds have parts. This exception is typically to allow for the coordinated action of living beings which are clearly composite but act as a composite whole. Philosophers who have held this view include Peter van Inwagen (van Inwagen, *Material Beings*, 1990) and Trenton Merricks (Merricks, *Composition as Identity, Mereological Essentialism, and Counterpart Theory*, 1999). Theories in accord with response number two include brutal composition (Markosian, *Brutal Composition*, 1998), the common sense view of composition, and two of my own that I present later in this thesis. These are all forms of restricted composition, that is, there are conditions under which some xs compose a y and different conditions under which those very same xs not only do not compose the previous object y, but no composite object at all.

Abstract/Concrete Distinction

The abstract versus concrete distinction is an important distinction as I will only consider the cases of composition between concrete objects. The problem with making this distinction is that, while many philosophers agree it is a distinction that is

of fundamental importance, there is no standard explanation of this distinction. There are clear paradigmatic cases of abstract objects² and clear paradigmatic cases of concrete objects³ but no explanation of why these should be ontologically distinct. The existence of abstract objects is both useful and controversial. (Dorr, There are no Abstract Objects, 2007) We use mathematics daily; we communicate ideas with propositions and can understand complex concepts so well that we can use them to improve our lives. We have good reason to believe in the existence of abstracta. In some cases the fusions of abstract objects seem intuitive and clear, for example the fusion of two sets of integers to form a superset of those two sets.⁴ In other cases these fusions are not intuitive, and confusing; consider the fusion of squareness and the integers. It is not clear what the fusion of these two incompatible concepts could be if such a fusion could exist. The integers and the property of squareness are such fundamentally different objects that it is difficult to motivate a reason for admitting these types of objects into our ontology without good reason.

The primary reason for ignoring abstracta is that there are many conflicting views about the nature of abstract objects⁵ and this makes it difficult to develop theories that are not going to conflict with some of the different views of the properties of abstracta. My second reason for ignoring this category of objects is

² Mathematical objects (numbers, sets), concepts, propositions.

³ Tables, chairs, planets, people.

⁴ It is controversial to equate membership with fusion, see Lewis, *Parts of Classes*, 1991, but this case is merely to illustrate that the some cases of fusions of abstracta are comprehensible.

⁵ Non-spatial, non-temporal, causally inefficacious, universal particulars, etc...

that theories of composition that include abstracta must solve a problem for which I do not have a solution. This problem, raised by Uzquiano, has to do with strongly inaccessible sets (Uzquiano, *The Price of Universality*, 2006). My last concern is that while I am able to, to a degree, describe the interactions of concrete objects using our best scientific theories, there is no methodical approach that explains the interactions of abstract objects with other abstract objects, or the interactions of abstract objects with concrete objects. Since there is no solution to these problems I am focusing my attention on composition involving only concrete objects; if I am able to explain composition in this category of objects alone that will be a significant result.

Summary of Project

I will be comparing the various theories for their ability to answer both the General and Special Composition Questions. It is also desirable that theories can if possible solve problems of material constitution and are consistent with the denial of metaphysical vagueness. The problems of material constitution and the reason for rejecting metaphysical vagueness are presented below.

Ship of Theseus

In Ship of Theseus cases one plank is removed from the ship, belonging to Theseus, and replaced with an indistinguishable plank. The original is then discarded (Plutarch, 75 A.C.E), but, unbeknown to Theseus, someone collects this discarded plank. (Hobbes, 1640)⁶ This continues over an extended period of time,

⁶ Plutarch considered only the case of replacement of parts; Hobbes added the complexity of collection and reassembly of discarded parts to recreate the original ship.

until all of the original planks have been replaced. An artifact can certainly survive being disassembled and then reassembled so if the collector now has all the original planks and reconstructs the ship out of the discarded lumber, each plank in relation to the others as they were on the original ship before this process began; the collector has now reassembled the original Ship of Theseus after it was disassembled. The problem is that we now have two candidate ships to be The Ship of Theseus. Which object (ship) is The Ship of Theseus?

The Ship of Theseus Puzzle is a problem because the following claims are incompatible.

1. The Ship of Theseus is composed of planks P_1, \dots, P_n .
2. The Ship of Theseus can survive the replacement of a single plank.
3. The Ship of Theseus can survive the replacement of each one of its planks P_1, \dots, P_n over time so that all planks are eventually replaced with planks P_{n+1}, \dots, P_{2n} .
4. Once all planks P_1, \dots, P_n have been removed from The Ship of Theseus, that is, the ship has been disassembled; they can be reassembled as they were in the original ship.
5. The Ship of Theseus survives disassembly and reassembly.
6. The Ship of Theseus survived the replacement of all its planks
7. The reassembled planks compose the same ship as original Ship of Theseus.
8. The two ships are not identical.

Any adequate theory of composition should tell us which of these (1 – 8) incompatible claims is false and why? Once the theory rules out a particular claim the merits of competing theories can be judged based on the plausibility of the verdict made in this case.

The Statue and the Clay

In these cases a lump of clay, called ‘Clay’, exists at a time t_1 . At some time later t_2 , a statue, called ‘Statue’, is fashioned out of the entire lump of clay. At some time t_3 , following t_2 , the statue is crushed leaving the entire lump of clay but not the statue. Here we are troubled because at t_1 Clay exists, composed of all its parts x_1, \dots, x_n , and at t_2 , there are two things, Clay, and Statue, composed of all and only the same parts x_1, \dots, x_n , as the lump. Alternately we could say there is only one object composed of the x s and that Statue = Clay. This is problematic though as Clay has many properties that Statue does not, for instance Clay has the property of existing at t_1 that Statue does not possess. For another example of a property not shared by Clay and Statue, consider Statue to have the shape of a cube. Clay need not have this shape, but it is an essential property of Statue. So we have two different objects composed of all and only the same parts.

1. Statue exists at t_2 , but not t_1 and t_3 .
2. Clay exists at t_1, t_2, t_3 .
3. At t_2 Clay has all the same parts as Statue so Statue = Clay
4. If 1 and 2, then Statue \neq Clay
5. Therefore, Statue \neq Clay

Claim 3 is incompatible with claim 5 but both are logically consistent with the facts of this case.

Problem of the Arbitrariness of Undetached Parts

Consider a whole man named 'Dion'. (Burke, Dion and Theon: An Essentialist Solution to an Ancient Puzzle, 1994) Now call the proper part of him that includes everything but his left foot 'Theon'. Unfortunately for Dion, today Dion has to have his left foot amputated. The physician performing the amputation takes his foot in such a way that only the proper part that we called 'Theon' is left. After amputation the foot is incinerated as it is medical waste. After the amputation one of the following must be true:

1. Both Dion and Theon exist.
2. Neither Dion nor Theon exist.
3. Dion exists but Theon does not.
4. Theon exists but Dion does not.

In case one Dion and Theon become one. Case one appears to be false because even though they share all and only the same proper parts, it is true of Dion that he once had two feet and this is not true of Theon. In case two all of what we called 'Theon' still exists and is the same as before Dion's foot was amputated so it seems that Theon does in fact exist. Case two appears to be false. In case three, Theon ceases to exist even though all of his proper parts exist and all of Theon exists as Theon did before Dion's foot was amputated. The amputation had no effect on Theon. Case three appears to be false. Case four seems desirable because all of Theon still exists but we do generally believe that a person, given proper medical

care, survives the amputation of a foot. We think it is false that Dion ceases to exist and is replaced by some new person, Theon. We have only four options and all of them seem to be false. The problem arises because after the amputation Dion and Theon have identical proper parts and different histories.

Problem of the Many (Unger, 1980)

Consider a cloud with clear blue sky all around this single cloud. From the ground it appears to be a well-defined cloud with a sharp boundary. When we study the cloud more scientifically we find, it is actually a collection of water droplets with the density falling off as we approach the lighter parts and eventually falling off so that we do not perceive a cloud in the area of the sky where this low density occurs. There is no well-defined cloud, no sharp boundary. There are many equally good candidate boundaries, each of which encompasses an equally good cloud candidate. How can there be just one cloud? Yet there is only one cloud. Each of the following eight claims appears to be true but they are mutually inconsistent.

1. There are several distinct sets of water droplets s_k in region R such that for each such set, it is not clear whether the water droplets in s_k form a cloud.
2. There is a cloud in the sky.
3. There is at most one cloud in the sky.
4. For each set s_k , there is an object o_k that the water droplets in s_k compose.

5. If the water droplets in s_i compose o_i , and the objects in s_j compose o_j , and the sets s_i and s_k are not identical, then the objects o_i and o_j are not identical.
6. If o_i is a cloud in the sky, and o_j is a cloud in the sky, and o_i is not identical with o_j , then there are two clouds in the sky.
7. If any of these sets s_i are such that its members compose a cloud, then for any other set s_j , if its members compose an object o_j , then o_j is a cloud.
8. Any cloud is composed of a set of water droplets.

(Weatherson, *The Problem of the Many*, 2009)

There is a cloud composed of water droplets. We have two candidate clouds o_j and o_i because each is composed of a set of water droplets that form a cloud in the sky. $o_j \neq o_i$ so there are two clouds in the sky, but this is inconsistent with 3, that there is at most one cloud.

This is not only a problem for the typical cases of clouds, mountains and heaps. It is also problematic when we consider cases that seem to have well defined boundaries. At any given time I may have several hairs that are still in my hair but the follicle has come out of my scalp. With even one of these that leaves two candidate Richards, the one excluding the hair that is loose, and the other that includes the loose hair.

This is a problem of vagueness. We are uncertain if a particular water droplet is a part of the cloud at the ill-defined boarder of the cloud. There are two potential

reasons we could be unsure. The first is epistemic; we may not be able to know what the clearly defined boundary of the cloud is. The other, more disconcerting form of vagueness is metaphysical vagueness; that the object, the cloud, is an object that has no clearly defined boundary. If the object is vague then there are many candidate objects, in our case clouds, and each of these candidate objects meets the criteria for composing an object. If each of these candidates meets these criteria there is good reason to believe in the existence of many clouds in the region that is occupied by the one vague cloud. This problem is good reason to try to avoid metaphysical vagueness if possible. There are other options, some of which will be covered later, but it is simpler if the problem can be avoided by developing a theory that avoids metaphysical vagueness altogether.

Chapter 2 - Nihilism

Nihilists contend that no object is ever the proper part of another object. There are several distinct forms of nihilism, all of which are unsatisfactory. The essential component of all nihilist theories is that composition does not occur. I will cover both nihilist and semi-nihilist theories. Pure nihilist theories can allow for the existence of our ordinary objects without the need to commit to these things being objects. Semi-nihilists, as we will see in the section on van Inwagen's Life Proposal, accept the commitments of pure nihilism, except for certain categories of composite material objects. Formally nihilism can be presented as:

Mereological Nihilism – Necessarily, for all x s, there does not exist a y such that the y is composed of the x s.

This view seems absurd to most people; after all we experience apparently composite physical objects regularly. We sit on chairs, at tables, in buildings, all of which are composite, and it would seem, also objects. The nihilist denies that these composite things are objects. The nihilist may allow for the ontological category Object, but contends that the only members of this category are mereological simples.

Entailments of Mereological Nihilism

No Composite Objects

The single most counterintuitive entailment of Mereological Nihilism is that there can be no composite objects. All of the things we think of as composite objects are not. Tables, chairs, buildings, people are all merely arrangements of

simples. If the nihilists are correct, anything with which we interact in our daily life is not an object.

To explain how our common sense and intuitions could be so mistaken about the nature of objects the nihilist can claim that all our talk about composite objects is really paraphrasing used to simplify our language. (van Inwagen, *Material Beings*, 1990) When we say “there is a table over there”, what we have paraphrased is “there are those simples over there and they are arranged table-wise.” Strictly speaking the phrase “there is a table over there” expresses the proposition there is a table over there which is false unless the table is an extended simple. The nihilist is able to say the phrase “there is a table over there” could express the proposition there are those simples arranged table-wise over there and, that this proposition is true. This does lead to a curious confusion as the phrase “there is a table over there” could on this account express the proposition there is an extended simple over there and it is a table. If the phrase “there is a table over there” expresses both the proposition there are those simples arranged table-wise over there and the proposition there is an extended simple over there and it is a table, we have to add a further condition to the paraphrase approach. We must stipulate that when speaking we do not ordinarily consider the difference between arrangements and extended simples in our paraphrase, but the vagueness in our language can be improved should the difference become relevant. When we say place the bowl on the table there is no need to distinguish which proposition is being expressed, this is in part why the paraphrase has become so common. The difference is important in metaphysics, not in ordinary situations.

Advantages

There are several advantages to nihilist theories of composition. Simplicity is the greatest advantage this theory has. Its answer to the special composition question is straight forward. There are no sufficient and jointly necessary conditions under which given some x s they compose a y . Answering the general composition question is just as easy. Given some x s the x s compose a y iff there is one x and $x=y$. (Markosian, Restricted Composition, 2007)

Ship of Theseus

The nihilist appears to have an easy solution to The Ship of Theseus puzzle. The nihilist can deny the first claim, that the ship is composed of planks. It is not composed of anything as composition does not occur. A consequence of this view is that the ship does not exist, at least it is not an object, and this seems a high price to pay. To avoid paying this price some nihilists will resort to claiming our linguistic conventions of using singular nouns and pronouns is a paraphrase for the arrangement of simples that is commonly referred to as a ship. The ship does not exist but the arrangement does.

The Statue and the Clay

The nihilist denies that Clay and Statue are objects. If they are not objects but arrangements of simples, then there is no longer a problem of having two different objects composed of all and only the same parts as these two arrangements are not objects. There is a sense in which Clay and Statue exist; 'Clay' is a name for a particular arrangement of simples that requires only certain proximity of the constituent molecules while 'Statue' is a name for an arrangement of those same

simples when the arrangement takes a certain form, or ordering. ‘Clay’ denotes a minimally structured arrangement of the xs and ‘Statue’ denotes those same xs and an arrangement with a particular structure to the arrangement. Though Statue and Clay are not objects, we use the singular nouns ‘Statue’ and ‘Clay’ to refer to arrangements of a set of simples, and do so as we would refer to a singular object. When we say “look at Statue,” the proposition expressed is ‘look at those xs arranged statue-wise.’

Problem of the Arbitrariness of Undetached Parts

Though accepting the second proposition, that neither Dion, nor Theon exist, seems absurd, this is exactly what the nihilist chooses. There are only simples arranged person-wise but no people. The nihilist has a solution to the Problem of the Arbitrariness of Undetached Parts.

This may seem hasty and uncharitable on my part, after all, the nihilist has options, the paraphrase option for instance, or van Inwagen’s semi-nihilism approach, so that people still exist. The nihilist can, and should at least allow that the name ‘Dion’ refers to a set of simples arranged person-wise and that ‘Theon’ refers to a set of simples arranged one-footed-person-wise. They could also say that the simples of the Theon set are a proper subset of those that are in the Dion set. These paraphrases do not carry the ontological commitment of object-hood for the sets of simples, but they do allow for truth-tracking of our statements about those sets of simples. What we say in common everyday usage of language is distinct from what we say when “*in the context of doing ontology*”. (Sider, *Against Parthood*, 2010) This is a

distinction that is not unique to nihilists. Many others⁷ who support restricted theories of composition will agree that common language is only appropriate for common sense mereology.

Uzquiano objects to this methodology (Uzquiano, Plurals and Simples, 2004) on the grounds that it is not completely general. The problem arises when we try to use plural quantification over composites. He asks us to consider the statement:

“The chairs outnumber the tables.”

There is no way to express the existence of a one to one correspondence between some of the chairs and all of the tables but not *vice-versa*, using only the first order quantification allowed by the nihilist’s paraphrase approach. The problems get worse in the cases of plural quantification over composites with predicates that take plural variables.

Uzquiano considers options to deal with the problems of plural quantification and predicates with plural variables. The first is plurally plural quantification. For this to work we create new plurally plural variables that range over pluralities of pluralities of simples. The statement ‘some cats are scattered’ would become ‘some cats_{es} are scattered.’ This is perhaps an option but a highly undesirable option as it is not well motivated by current use in the English language. Even if the work is done to introduce these plurally plural quantifiers there is still the

⁷ (Dorr, Cian, Fictionalist Approaches to Metaphysics, 2005), (Markosian, Restricted Composition, 2007), (Cameron, How to Have a Radically Minimal Ontology, 2010)

requirement to deal with the predicates that take plural variables. This is a huge amount of complexity and if there is an alternative to this it should be explored.

Another option, presented by Uzquiano, is to take second order variables to range over plural properties of simples. The nihilist seems committed to these sorts of entities anyway (*being arranged* _____), the nihilist should welcome the paraphrase of plural quantification over composites as the quantification of plural properties instantiated by simples. The problem remains in determining what plural properties of simples are? One suggestion Uzquiano considers is that they are plural universals and rejects these because “it is unclear that such a staggering ontology of plural and higher-order universals is independently motivated, and, in the absence of such independent motivation, it would certainly be disappointing if the nihilist and semi-nihilist had to resort to them in order to mitigate the counterintuitiveness [sic] of their position.” (Uzquiano, *Plurals and Simples*, 2004)

Problem of the Many

The nihilist denies the second claim that is a cloud in the sky. There are many candidate arrangements of simples so there is no one candidate arrangement for the paraphrase there are some simples arranged cloud-wise. Because there is no unique arrangement the nihilist must deny the existence of the cloud. This is an incredibly high cost for the nihilist as this can be generalized to include most sortals. (Unger, *The Problem of the Many*, 1980) Anything undergoing a transition is also subject to the consequences of the nihilist approach. Humans are constantly gaining and losing parts at the microscopic level, and at any given time there are many candidate arrangements for each individual. To solve the problem of the many the

nihilist must deny the existence of people, and any other objects undergoing gradual transitions.

Metaphysical Vagueness

Another advantage of mereological nihilism is that it is consistent with the denial of metaphysical vagueness. Consider an old book⁸ that has sat on the shelf a little too long. It has not been opened for several decades and the binding is beginning to fail. As you open the book various parts of the binding start to fail and then you start to read at the page you opened to. A small gust of wind blows that page from the book and it falls the floor. Once the page has fallen from the book it is clear that the page is no longer a part of the book, but there is no clear instant to which we can point to that the page ceased to be a part of the book.

The nihilist does not need to worry, as there are never any composite objects so no question of determining if composition occurs. Similarly for the converse, since there will never be a case of composition, the nihilist need not worry about considering at what separations two distinct objects will compose a third.

Material Beings

Peter van Inwagen recognized the problem that mental intentional states caused the nihilist position and wrote *Material Beings* (van Inwagen, *Material Beings*, 1990) as a response to this problem. The paraphrase response is inadequate when the subject of the sentence is a person. In the case of people there is the added

⁸ Thanks to Chris Tillman for suggesting this example.

problem of consciousness. We can say there are some simples arranged consciousness-wise, if we are materialist about consciousness, but this does not capture the singular nature of consciousness. When I say “I think that I am tall” I am the subject of the sentence. I am the subject of the sentence “I think I am shorter than I was this morning” later on that same day, even though there are different simples arranged consciousness-wise that are located in the same region as me.⁹ The thing that is my consciousness is the same, as it is still me that utters both utterances, the simples in each case are different.

Van Inwagen took the unexpected approach by accepting that living organisms were the one thing that the paraphrase approach could not handle and claimed that living organisms must be composite objects. He argued that we can explain the properties of non-living arrangements of simples as the cooperative activities of their parts, but that we cannot explain the properties of thinkers in terms of cooperative action. Thinking things must be objects because no part of a thinking thing can itself think.

Van Inwagen’s Life Proposal (VLP)¹⁰ – Necessarily, for any nonoverlapping xs, there is an object composed of those xs iff (i.) the activity of the xs constitute a life or, (ii.) there is only one of the xs. (van Inwagen, *Material Beings*, 1990)

⁹ Exdurantist would deny this claim.

¹⁰ Name given by Markosian, *Restricted Composition* 2007

Van Inwagen developed this theory to avoid problems with consciousness and thought. It may solve these, or it may not but it must still be able to solve the puzzles of material constitution so I will now present the solutions van Inwagen's theory allows for these puzzles.

Ship of Theseus

Ship of Theseus cases are not problems because the ship is not an object. Since it is not an object, but an arrangement of simples it does not have its parts essentially. The ship does not constitute a life so it is treated the same way a nihilist would treat any other object. In the case of those objects that do constitute a life there is no problem.

In the event that individual parts of a living being are replaced the life still exists. We are constantly shedding skin cells and losing hair yet we are still the same object because the life is the same. If a mad scientist collects all the replaced parts and puts them together in such a way as to create a doppelganger also living, the doppelganger, though similar is living a different life. The way in which life was created for the doppelganger would be different than the way in which life began for the original.

Statue and Clay

Statue and Clay cases are not problems because statues are not composite objects. Since Statue is not a living thing it is treated in the same way a nihilist treats the Statue and the Clay case. In the case of living things there is the moment at which life was created to distinguish between the nonliving and the living stages.

Consider a case where the parts of an object compose a life but the parts are arranged in different spatial locations at different times. Consider yourself when seated versus standing; the parts are the same though the physical arrangement differs. This different arrangement does not matter on van Inwagen's account as the object is that which constitutes a life. If the life is the same when seated and then standing then the object is the same object in the seated and standing configurations.

Problem of the Arbitrariness of Undetached Parts

Subsets of the living being are not separate living entities; they are subsets of the whole living being. Theon does not constitute a life independent of Dion while Dion still has his foot. Van Inwagen rejects the first claim that both Dion and Theon exist. The second claim that neither Dion nor Theon exist is also rejected by van Inwagen as Dion is a living being which constitutes the ontological status of composite object according to this theory. To sort out van Inwagen's position of the two remaining positions regarding the ontic status of Dion and Theon we must look at what van Inwagen calls The Doctrine of the Arbitrariness of Undetached Parts (DAUP) (van Inwagen, *The Doctrine of Arbitrary Undetached Parts*, 1981). He states:

DAUP: For every material object O , time t , and regions r_1 and r_2 , if m occupies r_1 at t and r_2 is a sub-region of r_1 then there is part of O that occupies r_2 at t .

If we consider Dion to be the object and the region occupied by Dion to be r_1 , r_2 to be the region occupied by the part of Dion called 'Theon', we can see that van Inwagen would say that Theon is a proper part of Dion. As this part is not a life, but

a part of a living being, van Inwagen would reject claim four, that Theon exists and Dion does not. This leaves case three, that Dion exists and Theon does not. Van Inwagen contends that composite objects exist in the case that they constitute a living being. Dion is a living being before the amputation. What happens at the moment of amputation to Dion? As we have already said, we like to think that an individual survives the amputation of a foot. When Dion minus the foot asserts “I used to have two feet.” --Given what we know about this case, we believe the proposition expressed to be true. The living thing, Dion, has survived the amputation even though it does not have all the same parts it did before the amputation. If this is true, Dion still exists after the amputation so van Inwagen can accept claim three.

There are other cases where this may not be so clear cut. In the case of Siamese twins there is no clearly defined distinction between the proper parts on one of the twins and the proper parts of the other. It seems as though there are some cases, separable Siamese twins, in which there are two lives and one object, at least until after the surgeon separates them. In other cases, inseparable Siamese twins, there are two people, one life due to shared organs and one object. The case of a pregnant mother is also problematic as the fetus is a proper part of the mother and yet we do think it constitutes a life independent of the mother once it has been born but the umbilical cord not yet cut. If my claims about these cases are true, and they seem to be, then the DAUP is false and van Inwagen has no solution to the problem of the arbitrariness of undetached parts.

Problem of the Many

For cases involving things that do not constitute a life, van Inwagen can say the same thing as the nihilist and reject the second proposition. Unless some simples constitute a life there is no composition.

In the case of a living being it may be true that subsets of the being are not objects but it may be indeterminate as to what constitutes the whole of the living being. We constantly shed skin cells, loose hair, etc... Consider the case of a hair that has been lost from the scalp but remains entwined with the others. It is still attached to your body, adds to your mass, contributed to how you look. It is not a living being so not an object, but should it still be considered a part of you? What about the skin cell on the top of your foot that remains there even though it is about to fall off? Should we consider it a part of you until it does fall? Is the air in your lungs that you are in the process of exhaling a part of you? What about the air that is just entering your nasal passages as you inhale? It is this vagueness that the problem of the many attempts to capture.

There is a problem when we consider the cases of living beings. In the case of living beings proposition one is true, as I said we are constantly shedding skin cells, losing hair, replacing vitamins and minerals in our bodies, so proposition one is true, there are several candidate people in my general region. Proposition two is true as there is a living being. Proposition three, that there is only one living being is also true. Van Inwagen is able to reject proposition four that for each subset of the living being there is also an object composed of that subset.

Van Inwagen contends that this indeterminacy is the result of assuming the part-hood relation is determinate (van Inwagen, *Material Beings*, 1990). He suggests that we adopt a fuzzy logic and can make claims like it is true to degree n that x is a part of y , where n is a value between 0 and 1, giving a probability that the x is a part of y . With this tool we can still have indeterminacy in the part-hood relation, but still have only one living being located where its parts are located.

Objections to VLP

Entails Metaphysical Vagueness

It is unclear how the fuzzy logic system van Inwagen proposes resolves the indeterminacy at the heart of The Problem of the Many. (Hudson, *A Materialist Metaphysics of the Human Person*, 2001) Consider a living being composed of n simples. Originally we had to determine if a particular simple was part of the living being or not. This meant that there were 2^n possible subset beings. If we use van Inwagen's fuzzy logic approach there are now continuum many possibilities for each simple that composes the being. If I choose a particular simple I must now determine to what degree it is part of the being and this could be any of the infinite numbers between zero and one. Admittedly there will be clear cut cases of simples that are a part of the being, but not all of them. In the case there is indeterminacy of a single simple we have now gone from 2 possible beings to many more. Van Inwagen also gives no metric by which one could determine this degree so it seems at best it is a guess.

There is another sense in which van Inwagen's theory entails vagueness. The theory requires a definition of what activities constitute a life. We have some basic

idea, it is the activities by which the parts accomplish the various tasks required to sustain life, but we have no definition of what that thing, life, is. It is quite different between micro-organisms and humans for instance. There have been many attempts at defining life and the following is the best that I have found.

Living organisms are autopoietic systems: self-constructing, self-maintaining, energy-transducing autocatalytic entities” in which information needed to construct the next generation of organisms is stabilized in nucleic acids that replicate within the context of whole cells and work with other developmental resources during the life-cycles of organisms, but they are also “systems capable of evolving by variation and natural selection: self-reproducing entities, whose forms and functions are adapted to their environment and reflect the composition and history of an ecosystem. (Webber, Life, 2008)

This seems an excellent definition, broadly inclusive of almost anything I can think of that we would consider a living being. There may be beings that we will consider to be alive that do not fit this definition but we can accommodate them as they are discovered. There may be vagueness, but this is due to incompleteness in the field of Biology, not a metaphysical or epistemic vagueness.

There may be cases where, given the requirement to determine if a particular arrangement of simples constitutes a life is not possible. If this were the case then there would be genuine metaphysical vagueness as a result of van Inwagen’s theory. Consider the lowly virus. The study of viruses has led to an open debate in the field of biology as to whether or not a virus should be considered a living being. In the late 19th century viruses were first identified as the cause of some diseases: rabies and foot-and-mouth. (Villarreal, Are Viruses Alive?, 2008) In 1935 they were demoted to

the status of chemical when Stanley was able to crystalize a virus and saw that it lacked the systems required for metabolic function. He won the Nobel Prize in Chemistry for this achievement. (Villarreal, Are Viruses Alive?, 2008) Study since then has determined that once a virus enters its host cell it borrows the components required for metabolic function and causes the host to replicate the components required to produce copies of itself. It does this using its own DNA and RNA. In the case of the virus there are senses in which it is both living and non-living. This could be a case where there is no determinate answer to the question of whether a virus is a living being. If there is in fact no answer, or there are other candidate beings that we have not discovered that cannot be living, but are not non-living either there is a problem of metaphysical vagueness for van Inwagen.

The next problem I raise for van Inwagen's view is the possibility of gunk.

Gunk – A composite object where there are no atomic parts. Any part taken from a gunky object is itself gunky and also divisible; this continues *ad infinitum*.

Theodore Sider objects that van Inwagen's view is false since gunk is possible.

Sider's argument is as follows (Sider, Van Inwagen and the Possibility of Gunk, 1993):

1. Possibly, there exists a gunky world with gunk arranged to form tables, chairs and other inanimate objects.
2. If van Inwagen's view is correct, then for any material object X, the Xs compose something iff the activity of the Xs constitutes a life, or there is only one of the Xs.

3. Van Inwagen claims that every material object is either a mereological atom, or a living thing.
4. Van Inwagen intends to defend the view that (3) is a necessary truth as he makes no claims of contingency.
5. If (3) were necessarily true, then $\sim(1)$
6. (3) is not necessarily true
7. Since (2) entails (3), (2) isn't necessarily true either.

According to van Inwagen you are a composite object because you are alive.

Presumably all the molecules are parts of you, but they are not alive. You can be subdivided into molecules, but these are not living, so are not objects. If these are not objects they are mere arrangements, and this continues to the subatomic particles where the regress stops. The point here is that the regress stops, so you are not gunky. Sider has in mind cases of genuine metaphysical gunk, where all subparts of the original object are themselves gunky. If this is the case, then there are no simples and so no arrangements of simples in this gunky world. There could not be any objects in a gunky world if the nihilist is correct. If van Inwagen is correct, the only objects in a gunky world would be living beings.

Composition as Fiction



Figure 1 (Dorr, *Composition as a Fiction*, 2002)

Consider the region enclosed by the box above (Region R^{11}) where a , b , and c , are simples. A and B are stuck together such that when forces are applied to one of the other or both they move as a unit. C is independent of A , B , and AB . When asked how many objects occupy region R the typical answer is four, A , B , C , AB . This is the common sense response as there are the three simples plus the composite particle composed of A and B (AB , since it acts as a whole). The nihilist contends that there are only three objects A , B , and C . The composite object AB does not exist.

Dorr and Rosen present a method by which one can resist van Inwagen's argument for the existence of composite wholes. They provide the following canonical method with which to eliminate the mereological commitments to any theory. (Rosen, 2002)

¹¹ As Dorr and Rosen do in Dorr/Rosen.,2002

1. *replace every occurrence of 'there is something which' with 'there are some things which'*
2. *replacing every occurrence of 'for everything' with 'whenever there are some things'*
3. *replacing every occurrence of 'is part of' with 'are among' (the xs are among the ys iff whenever something is one of the xs, it is one of the ys).*
4. *replacing every occurrence of 'is identical to' with 'are the same things as' (the xs are the same things as the ys iff for anything, it is one of the xs iff it is one of the ys)*
5. *replacing every singular predicate in the theory with a new plural predicate. Thus 'is a molecule' is replaced by 'are arranged moleculewise', 'has mass M' is replaced by 'have mass M', 'is located one nanometer away from' is replaced by 'are located one nanometer away from' (Rosen, 2002)*

This method of eliminating mereological commitment does not contain any of the predicates contained in the old theory and so is not logically entailed by the old theory. To choose the old theory rather than the new that this method creates one would need scientific evidence that the old theory is more effective than the new. This is no easy task as the method is in effect a paraphrase for creating nihilist acceptable transcriptions out of the compositionalist theories of mereology.

Monism

Monism is the view that “there exists only one (non-abstract) object: the entire world.” (Sider, *Against Monism*, 2007) The monist is able to account for the truth of our statements about the world in a way similar to the paraphrase method of

the nihilist. When one states “there is a table over there.” the nihilist contends that expresses the proposition there are some simples arranged table-wise over there. The monist contends that that statement expresses the proposition the world has the property of being table-wise over there. The world is a single object with various properties such that what we say of our experience of the world accurately (or not, depending on the verity of our perception) conveys these properties of the one existent object, the world. The monist is able to speak of “modes of the world” (Schaffer, 2007) rather than deal with the problems for PVI, who cannot call limbs parts of a person, but must account for the collective action of simples in intentional living beings.

Sider’s Objection to Monism

Sider argues that the pluralist is able to explain why the combinations of possibilities are such as they are while the monist cannot.

“Consider a world containing just a single computer screen with a 4x4 pixel resolution. Each pixel can be on or off. Since there are 16 pixels, and there are two states for each pixel, 216 states are possible for the entire screen.” (Sider, *Against Monism*, 2007)

In this world the pluralist is able to explain why the combinations of possibilities are a power of 2 while the monist cannot. “When one speaks of a property of a fundamental fact, monism requires that that fundamental fact is a fact about the whole world.” (Sider, *Against Monism*, 2007) Given any binary relation on occupation of a particular state for a given pixel the pluralist is able to explain why the combinations of possibilities are a power of 2. The monist is not able to do so.

Given the greater explanatory power of the pluralist position, pluralism is the preferred theory.

Conclusion

Nihilism, though not without its problems is a superior theory to the semi-nihilism proposed by van Inwagen. The life proposal was not well motivated, in that it was an attempt to solve several problems of consciousness but did so by assuming that thinking things had to be different from non-thinking arrangements that served higher order purposes. A car is an arrangement that does many things the parts could not do were they arranged differently, and there is no reason to believe that we are somehow different. To make matters worse for van Inwagen, there were several problems of material constitution for which he did not have solutions when we considered cases involving living beings.

The nihilist theories did better at solving problems of material constitution, but as Uzquiano showed, the increased mereological simplicity came with other ontological complexities and it is not clear that the benefits of nihilism outweigh these costs.

Lastly the Monist is able to speak about modes of the world, without being able to explain fundamental facts because fundamental facts are fact about the whole world. Given the choice between monism or the problems of pluralism and the greater explanatory power of pluralism, pluralism is the preferred theory.

None of the nihilist theories presented was able to solve all of the problems of material constitution. Given this failure it is best to look for an alternative.

Chapter 3 - Universalism

Unrestricted Mereological Composition

Unrestricted composition is the theory that composition always occurs.

Formally this is expressed as:

Unrestricted Composition – Necessarily, given some x s, there is always a y such that the y is composed of the x s.

The first advantage of the Universalist approach is that all the ordinary objects we consider to be composite objects are indeed objects. This is a huge advantage over Nihilism. The theory also gives an incredibly simple answer to the Special Composition Question: always. The Universalist also has an answer to the General Composition Question. The x s compose y iff the x s and y exist.¹² Composition just is. Fusions of any x s exist; there is nothing special or unique about fusions that can be discerned because they always occur.

In the previous chapter the nihilist position seemed to have far too few objects, though not a fatal objection, it is a cost to the theory. Lewis contends the only way we will get enough objects is to accept Unrestricted Mereological Composition. “On pain of accepting brute facts, it would appear that any attempt to do away with queer sums by restricting composition would have to do away with too much else besides the queer entities; for queerness comes in degrees whereas parthood and existence cannot be a matter of degree.” (Lewis, *On The Plurality of*

¹² Thank you to Chris Tillman for pointing out this answer to the GCQ.

Worlds, 1986) Given the Universalist position, that composition always occurs there is no shortage of composite objects.

Universalism does not make any claims about material constitution, but there are various theories of material constitution that are compatible with Universalism and I will present some of these theories and then I will present the various solutions to the puzzles of material constitution.

Four Dimensionalism

Perdurance is the view that you are composed of not only spatial but also temporal parts. Just as there is a part of you, your right arm for instance, that occupies a portion (but not all) of the space you occupy, there are parts of you that occupy times that are not all concurrent. There is a 1976 part of me and a 2009 part of me and these are very different parts, as I was born in 1976. Objects exist as space-time worms. This is in opposition to the endurantist position, that objects are wholly present at the current time.

Sider provides a comprehensive exposition of four dimensionalism in his book of the same title (Sider, *Four-Dimensionalism: An Ontology of Persistence and Time*, 2001) and I will not provide further detail here except to note that many other philosophers have held this view including, Lewis (Lewis, *On The Plurality of Worlds*, 1986).

I should also note that there are various four dimensionalist theories. There are some who believe that only past parts exist and that future parts are yet to come into existence. Others think past, future and present parts exist. I will not cover

these various forms as this is not necessary when solving the puzzles of material constitution.

Mereological Essentialism

Mereological essentialists contend that an object has its parts essentially. (Chisholm, 1973) This theory has the unexpected consequence that by rearranging the parts of an object you do not change that object, merely the arrangement of its parts. Consider object O, a table composed of four legs and a top. The mereological essentialist must say the object O exists even when the legs are separated from the top and it is no longer a table but a collection of table parts. It is the same object but is no longer arranged as a table. This theory is compatible with Universalism because given any parts they always compose a whole; in fact they compose the same whole, no matter the arrangement of the parts.

Relative Identity

Relative Identity Theory rejects the existence of a relation of absolute identity, only relations of relative identity. Identity is always relative to a kind.

Formally, relative identity can be expressed:

Relative Identity: x and y are the same F and x and y are different Gs.

(Deutsch, Relative Identity, 2007)

This can be true even if both x and y are Gs, so long as they are different Gs. Two girls are both girls just not the same girl.

Ship of Theseus

This is a case where we are concerned with diachronic identity conditions, that is, conditions that hold across different times. We begin at time, t_1 , with a single ship and at some time in the future, t_n , there are two ships.

On the perdurantist account the Ship is composed of instantaneous temporal parts in addition to the planks. There is a part of the ship at t_1 , and a different part of the ship at t_2 . When we combine universalism with perdurance, any collection of these stages composes an object. There are many such collections and consequently many such objects. The worm that results in the replacement ship is composed the following stages:

1. The original ship
2. Ship 1 stage after the replacement of plank 1
3. Ship 2 stage after the replacement of plank 2
4. .
5. .
6. .
7. Ship n stage after n planks have been replaced

There is a corresponding worm for the reconstituted original ship. There are also many other worms that begin with the original ship stage. The Ship of Theseus puzzle requires us to choose the appropriate worm. Sider contends that “the metaphysical puzzle has been dissolved. We have a perfectly clear metaphysical picture of what happens: the world contains space-time worms corresponding to both answers to our question.” (Sider, *Four-Dimensionalism: An Ontology of*

Persistence and Time, 2001) There is no answer to the question which of the ships is the Ship of Theseus but we do not need one because the question is no longer one of material constitution. It is a question of which of these worms counts as a ship.

The mereological essentialist thinks of this case much differently than we do. Let the essentialist call the original ship composed of planks P_1, \dots, P_n, O_1 . When we take out P_1 and replace it with P_{n+1} , the essentialist contends that O_1 still exists; it is just not arranged the same way. What we would call “the ship with a single replaced plank” the essentialist would call a different object say O_2 , composed of parts P_2, \dots, P_{n+1} . There is no paradox because an object cannot survive the replacement of any of its parts.

The relative identity theorist, or relativist, has no solution to this puzzle. We have three ships in this puzzle, the original Ship of Theseus (1), the ship composed of replacement planks (2), and the ship composed of the replaced planks (3). The problem for the relativist is that 2 appears to be the same ship as 1, 3 appears to be the same ship as 1, so by transitivity we get the absurd result that 2 is the same ship as 3. The relativist must deny transitivity, which is good reason to suspect that relativized identity relations are not identity relations. (Deutsch, 2007)

The Puzzle of the Statue and the Clay

The perdurantist solution to the puzzle of the Statue and the Clay is incredibly simple and intuitive. Consider the Trans-Canada Highway. This highway runs east-west and joins all ten of Canada’s provinces. The part of this highway that runs from the Perimeter Highway to Main Street in Winnipeg is called Portage Avenue. Portage Avenue is identical to the proper part of the Trans-Canada

Highway running from the Perimeter Highway to Main Street in Winnipeg. We say the Trans-Canada Highway “turns into, or becomes” Portage Avenue. The perdurantist says the Statue and the Clay case is a case like that, but instead of the spatial parts we need to consider the temporal parts. Clay becomes Statue for a period of time and then Statue becomes Clay after a period of time. Statue is a proper temporal part of Clay.

Statue and Clay cases are not problematic for the essentialist as the object is the thing composed of the parts. The arrangement of those parts changes when Clay is molded into statue, but because the parts are the same, the object is the same. ‘Statue’ denotes a particular arrangement, and that arrangement has different properties than Clay, but there is still only the one object and it exists, no matter the arrangement of its parts.

It may seem counterintuitive that the one object has incompatible properties, but it is the arrangements that allow for this. The object does not have the property simpliciter. The object arranged in a certain way has the property. Clay is the object with the parts arranged such that it forms a solid. The shape is irrelevant. Statue is the same object with its parts arranged in a particular spatial arrangement.

The relative identity theorist, relativist, has a solution to this problem, but I must add a layer of description to the case. I used just Clay and Statue when I set out this puzzle in chapter one, but I need to be more explicit. Let Clay denote a particular arrangement of the lump of clay, but an arrangement distinct from the arrangement that is Statue.

The relativist says that identity is always relative to a kind so Clay is the same statue as Statue is true and Statue is the same lump of clay as Clay but Statue is not identical with Clay.

Problem of the Arbitrariness of Undetached Parts

Perdurantism allows a simple solution to this problem. Consider the first temporal stage to be the stage before Dion's amputation, where Theon also exists as a proper part of Dion. The next stage, assuming an instantaneous surgery and destruction of Dion's foot, is the stage after the surgery where the foot has been destroyed; leaving all of what was the proper part of Dion, called Theon. There are two distinct things with different properties, the two temporal parts are different and they have different properties. Dion is the fusion of all of these temporal parts; the temporal parts can have different spatial properties. "Change over time for the four-dimensionalist is thus a matter of dissimilarity between successive temporal parts." (Sider, *Four-Dimensionalism: An Ontology of Persistence and Time*, 2001)

The Universalist Mereological Essentialist would deny that Dion could survive the loss of his foot. So he would accept proposition four, that after the amputation and destruction of the foot Theon exists and Dion does not. This is problematic as Theon might assert the proposition that I used to have two feet. This proposition would be false according to the Mereological Essentialist. Dion had two feet; Theon only ever had one foot. Not being able to survive bodily changes is an extraordinarily high price.

Relative identity theorists have a solution to the problem of the arbitrariness of undetached parts. In Geach's formulation (Wasserman, 2009) of Relative Identity

Theory there is no relation of absolute identity, only relations of relative identity. Identity is always relative to a kind. If this is true then the material of Dion, before the amputation is not the same material as Theon but the person Dion is still the same after the amputation and only the material referred to by 'Theon' exists, because the kind we are concerned with is person, not object. Dion the person survives the loss of his foot because he is relatively identical to the kind in question. This solution is not without severe consequences. The relativist must deny extensionality. Consider two sets A and B. If A has the same members as B then $A = B$. Member is not a kind so there is no relative identity relation expressed by the proposition same members as.

Problem of the Many

The problem of the many is a question of synchronic identity, a question of identity at a time. Perdurantism is a theory of persistence through time so the perdurantist must seek an independent theory of synchronic identity. I will present several following the mereological essentialist's position.

The mereological essentialist does not allow for vague objects. The universalist essentialist would deny claim three, that there is at most one cloud. Each set of water molecules composes an object and those objects are in this case, within region R, clouds. Many of these objects overlap but any candidate set s is an object and it is a cloud.

I will follow Wasserman in his presentation of the Problem of the Many (Wasserman, 2009) for the Universalist.

Relative Identity

If the Universalist denies claim six, that there are two clouds, they are claiming that two candidate clouds are distinct candidate clouds but the same cloud. Wasserman presents the following objection: Let a be an atom in O_1 but not O_2 . By Relative Identity the atoms in S_1 compose O_1 and the atoms in S_2 compose O_2 , and though O_1 and O_2 are different fusions of atoms, they are the same cloud O . If O_1 is the same table as O_2 then O_1 should have the same properties as O_2 . O_1 has the property of having a as a part and O_2 does not. O_1 and O_2 have different properties so O_1 and O_2 cannot be the same cloud O .

I will now present two other potential solutions to the problem of the many that the perdurantist could adopt.

Overpopulation

The Universalist has a surprisingly simple solution to the Problem of the Many. They will accept the first proposition, that there are many distinct sets of atoms S_n , such that for each set of the atoms it is not clear that there atoms form a cloud. They will also accept proposition two, that there is a cloud. The Universalist can then reject proposition three, that there is one cloud. By rejecting this claim the Universalist is committed to the existence of many clouds all located roughly where the apparently one cloud is located. This is a cost but compared with the nihilist's cost of denying the existence of clouds it does not seem so bad. No one has really defended this position but it is an option available to the Universalist. There will

obviously be a high price to pay as this approach causes extraordinary difficulties when it comes to naming and creating a story that explains singular reference.

Vagueness

If the Universalist can deny that every O_n is a cloud then the Problem of the Many collapses because there will be just one cloud and the proper parts of that cloud will not be clouds. One way to do this is for the Universalist to claim being a cloud is an intrinsic property. Weatherson considers this in section called “Argument from Duplication.” (Weatherson, 2009) If this is true, then O 's being a cloud does not depend on any changes external to O . The loss of atoms will not matter so there will be no candidate clouds. This does not seem to be likely. If we were to add material to the cloud, say double the volume of water droplets, there would still be just the one cloud but the fusion of the parts of the original cloud remain. This fusion of the parts of the original cloud is now a proper part of the new cloud, before it was the entire cloud. Even though it had the property of being an entire cloud this fusion now has only the property of being a proper part of a cloud.

In the section titled “Argument from Similarity” (Weatherson, 2009) Weatherson presents Unger's attempt at solving the Problem of the Many. For some atom a_i , O_i is a typical cloud. Anything that differs minutely from a typical cloud is a cloud. O_j differs minutely from O_i . O_j is a cloud. The problem with this attempt is that the fusion of a cloud with a single atom from a mountain is not a cloud and yet it differs from a cloud by only one atom.

The final attempts to overcome the problem caused by vagueness Weatherson calls the “Argument from Meaning.” (Weatherson, 2009) If there is exactly one O_i that is a cloud, then there must be a selection principle that picks O_i over the others. For this to work one must accept some theory of vagueness of which he considers Epistemicism.

The Epistemicist claims that vague terms like ‘heap’, ‘bald’, or in this case ‘cloud’ are semantically determinate. The semantic facts that make these terms determinate are beyond our knowledge. In this case there is a semantic fact that will pick out the appropriate cloud we just do not and possibly cannot know this fact. Most will find this view objectionable because these brute semantic facts are beyond our grasp.

Objectionable Consequence

There is one disadvantage that most individuals find offensive when they are first presented the consequences of this theory: there are far too many objects. Given any x s they always compose an object, so given your left arm, my desk, and the chair in which I am seated, these three objects compose a fourth. There is no name for this object but we could give it one. Once it has a name we can refer to it by name, describe its properties, and even destroy this object by destroying its parts. There are a multitude of objects, far in excess of all the ordinary objects that exist. If we can develop a restricted theory of composition that is able to answer the Special and General Composition Questions, solves the problems of material constitution, and gives us all and only the objects we want that theory would be preferable to Unrestricted Mereological Composition.

Chapter 4 - Restricted Composition

Contact

The Contact theory of Composition is typically the first theory that an individual is likely to propose if asked the Special Composition Question. It reflects our common, everyday experience of our world.

Contact Composition – Necessarily, for any nonoverlapping x s, there is an object composed of the x s iff the x s are in contact with one another. (van Inwagen, *Material Beings*, 1990)

Objections

The theory seems intuitively correct, but with even cursory reflection fails in two ways. The theory is both too broad and too narrow. Consider walking down the street on a sunny afternoon holding the hand of your best friend. Both you and your friend are in contact with each other and therefore compose an object that has each of you as its component parts. If you are holding this book while reading it you and the book compose an object. If you are seated while holding the book you and the chair compose an object, but rather strangely, you the book and the chair do not compose an object. We could allow that as long as there is a continuous chain of contact then the parts compose a whole, but then the book, you, your chair, the floor on which the chair rests, ..., all these things compose an object. This is an unsatisfactory result for those who reject Unrestricted Composition and want a restricted form more in keeping with common experience.

The theory is also too narrow as modern physical theories do not place the constituent parts of, molecules, atoms, and other more exotic composite particles

into contact with each other. The electron orbits the proton to form a hydrogen atom. There is no contact between them but we would like these parts to compose a whole.

Fastenation

This theory is an attempt to correct for the broadness of Contact Composition. Fastenation does not address the problem of narrowness but solving one problem at a time is usually the best method in resolving a list of objections.

Fastenation Composition - Necessarily, for any nonoverlapping xs, there is an object composed of the xs iff the xs are fastened together. (**van Inwagen, Material Beings, 1990**)

The best attempt at defining ‘fastened together’ is something like:

Fastenation - given any xs, the xs are fastened together if they are somehow stuck together.

This is the naïve theory of composition that most will consider once they have been told that contact is too broad; there is some reason that the objects must be in contact. Van Inwagen objects to the theory by giving the case of two men holding hands whose arms are suddenly paralyzed. (van Inwagen, *Material Beings*, 1990) According to the theory they are unable to stop holding hands so they now compose an object. They did not compose an object when holding hands but were able to let go, but now paralysis has caused them to be stuck together so the conditions for Fastenation Composition are met and they compose an object. This is an undesirable consequence.

Weak Fastenation is an attempt to define Fastenation by using a systematic approach.

Weak Fastenation - Necessarily, for any nonoverlapping xs, there is an object composed of the xs iff the xs are fastened together to some degree greater than zero.

The degree is relative to other objects. It could in principle be determined by measuring the force, or perhaps energy, required to separate the component parts of an object.

This attempt at improving upon the definition of Fastenation does not solve the problems that Fastenation has. It also does not account for varying degrees of Fastenation. Consider the force required to tear a hair from my head, and compare it with the force required to tear off my left arm. The arm is fastened to a higher degree than the hair, yet they are parts of the same person, me. There are varying degrees of Fastenation within one object.

n-Fastenation - Necessarily, for any nonoverlapping xs, it is true to degree n that there is an object composed of the xs iff the xs are fastened together to degree n .

This is a means by which the varying degrees of Fastenation are taken into account. In the previous example my hair and my arm were fastened with two different degrees. They could still be parts of me so long as they are both attached with a degree greater than n . This n is the problem. Determining the n is not easy to do, this value based on our opinions of objecthood. We first decide that a collection is an object and then we determine the degree to which these parts are attached.

Weak Fastenation with Degrees - (i) necessarily, for any nonoverlapping xs, there is an object composed of the xs iff the xs are fastened together to some degree greater than zero. (ii) Necessarily for any nonoverlapping xs fastened together to some degree greater than zero and for any x among those xs, x is a part of the object composed of the xs to the degree to which x is fastened to the rest of the xs.

The varying degrees of Fastenation are accounted for by combining the two previous theories. It is hard to define Fastenation, so much so that I do not think there will be a way to answer the General Composition Question if we use this method to answer the Special Composition Question. Atoms must be fastened to the nucleus even without contact, legs are screwed to a tabletop, and arms are glued to a chair. These are all fundamentally different ways to fasten objects together with no common underlying physical feature.

Brutal Composition

The goal Ned Markosian set for himself when he first proposed the Brutal View (Markosian, Brutal Composition, 1998) was to create and defend a view that is consistent with pre-philosophical intuitions about the world's composite objects.

Brutal Composition - There is no true, non-trivial and finitely long answer to the special composition question. (Markosian, Brutal Composition, 1998)

Markosian claims that we are unable to give an explanation of what is required for composition to occur. He insists that there is a fact of the matter, that composition occurs in some cases and not others, but that we are unable to determine the causes of composition, and do not know what the composition

relation is. There is a brute fact of the matter that composition occurs in some cases and not others. It is possible that we will never be able to determine what the composition relation is, and why it occurs between some objects and not others. The unfortunate consequence is that while it does what he set out to accomplish, it does so at the expense of ever being able to answer the General Composition Question or the Special Composition Question.

Markosian himself admits that composition is not the sort of thing that appears to be brute. “The difficulty, I think, is that SCQ itself is such a natural question to ask that one assumes that there must be an interesting answer to it.” (Markosian, *Brutal Composition*, 1998) The argument Markosian uses to motivate acceptance of this counterintuitive theory is the argument from elimination. He demonstrates that his theory is the best default theory because all of the others that existed at the time writing (1998) were unacceptable. This is good news for those who wish to reject Brutal composition because it leaves open the door to producing a better theory.

Ship of Theseus

There could still be two Ships of Theseus as there is no claim about this puzzle with which the brutal view is incompatible. It may be true that one of the claims is incompatible with the brute facts of the matter approach, but there is no way to tell. If the brute facts are such that each claim in the puzzle is true then the puzzle is unresolved by the Brutal view.

Statue and Clay

The Statue and Clay cases are not easily resolved because of this theory as both statue and clay could be objects. There is a fact of the matter but we do not

know what that fact of the matter is. Clay could exist and 'Statue' could just be the name of Clay when it has a certain form. If this is true then there is no puzzle, if Clay and Statue both exist then the puzzle remains unsolved.

Problem of the Arbitrariness of Undetached Parts

The Brutal Compositionist may have cause for denying the first claim that both Dion and Theon exist after the amputation. A proper part of Dion is now destroyed and it seems that there is no reason to suppose that both still exist. This is not definite, but there are only brutal facts about composition of particular objects on this account and they are not known. It is easy to reject the second claim, that neither Dion, nor Theon exist as Theon existed before the amputation and nothing has been done that would change the ontological status of Theon. The problem which remains is that there is no way to choose between claim three, that Dion exists, or claim four, that Theon exists. There is most assuredly a fact of the matter, a brute fact; there is just no way of knowing what that fact is.

Problem of the Many

Finally there is a problem Brutal Composition solves. It seem as though it is ideally suited to solve this problem. The key aspect that gets this whole problem up and running is the first claim, that there are many distinct sets of atoms, S_n , such that for each set of the atoms it is not clear that these atoms form a cloud. The brutal view claims that there is a brute fact of the matter in this case. We may not know what that brute fact is, but there is a brute fact that some atoms clearly compose that cloud.

As with Universalism, it seems that BC provides no solution to any of these on its own. If the brute facts turn out to be one way, there's one solution. If another way, there is no solution. The view issues no verdict all by itself.

Serial Response

There have been several attempts¹³ to provide series type responses to the Special Composition Question. These attempts all assume that there is no single response that will correctly answer this question. By giving a concatenation of answers that work for specific types of cases, the hope is that we will be able to give adequate answers to all types, giving a complete answer to the Special Composition Question.

The Serial Response – The correct response to the Special Composition Question takes the form of a series. (*Markosian, Restricted Composition, 2007*)

Markosian raises two objections to serial responses in his Brutal Composition paper. (Markosian, Brutal Composition, 1998) The first is that no one has yet been able to develop a solution for each type of objects, so the series is incomplete. This is not a metaphysical objection, rather an objection to the claim that we should ever be able to complete the task. It is no small task as one must first determine the composition conditions, or brute facts for a specific kind. One would have to determine this for say the kind Person. This is difficult, but then this must be done

¹³ van Inwagen, 1990 Ch. 7, Markosian, Brutal Composition 1998

for each and every other natural kind. The answer to the Special Composition Question would then take the form: Composition conditions for kind Person + Composition condition for kind Table + Composition condition for kind Star+... This serial type of answer is certainly impossible to complete as each natural kind would have a corresponding set of conditions that must be included in the conjunction. The series would take a form like:

(SERIES) Necessarily, for any non-overlapping xs, there is an object composed of the xs iff either the xs are F1s and related by R1, or the xs are F2s and related by R2, or ... the xs are Fns and related by Rn. (Markosian, Restricted Composition, 2007)

The second objection is that serial types of solutions do not solve the problems to which other types of solutions are vulnerable. In providing an answer for each type, each answer cannot allow metaphysical vagueness, or any of the other objections that have been raised against other theories. There is an additional worry when creating the series. All the cases must be linked in such a way as to be considered cases of composition. These can be very different types of composition as we saw when considering Fastenation. The serial response is also open to counterexample objections and we first need to determine the functions (the Fs) and the relations (the Rs).

Multifactor Approach

There are many types of Fastenation to consider as there are many different types of objects. This was precisely the problem for using Fastenation in an attempt to answer the Special Composition Question. There could even be other factors we have not yet considered that would be relevant in our attempt to formulate a solution

to the Special Composition Question. The Multifactor Approach allows several factors to be considered in a weighted formula that requires a minimum threshold be reached to determine composition has occurred.

Markosian illustrates the method by presenting a simplified theory of the type he calls the Fastenation + Contrast view.

The Fastenation + Contrast View - Necessarily, for any non-overlapping xs, there is an object composed of the xs iff the sum of the degree of fastenation among the xs and the degree of contrast between the xs and their environment is greater than or equal to 1.5.

(Markosian, Restricted Composition, 2007)

This is merely illustrative, not intended to provide an answer to the Special Composition Question.

There are several advantages to this type of theory. First, it is simple to construct. One need only determine experimentally the appropriate weights for different types of Fastenation and then the appropriate threshold for composition. It also does away with metaphysical vagueness. There is a mathematical answer to the Special Composition Question. We must measure the required parameters for individual cases, but there is a determinate answer to the Special Composition Question. The Multifactor Approach is also more pleasing than the Brutal View as we have reasons we can know that explain our intuitive view of objects.

Despite all these advantages, The Multifactor Approach suffers from the same objections as the Serial Response. Developing this sort of solution is a

monumental undertaking not likely to be accomplished in our lifetime. Developing this response relies on our intuitive concepts of what it is to be an object and as a result we would create an equation that follows those intuitions. This most certainly would include solid metaphysical knowledge, but would require fine tuning and adjustment as we learn more about composite objects. The Multifactor Approach is as likely to provide us with an answer to the special composition question in the same time as physicists are to providing us with a complete and correct theory of physics. Both these pursuits are interesting and provide valuable results, but the end is not within sight in either case.

Conclusion

Our intuitions about Mereology lead us to restricted views but these are difficult to develop. Potential problems with vagueness, counter-intuitive results, problem of degrees, and implausibility are all genuine concerns. Given these problems many have given up and accepted Universalism or Nihilism rather than try to use restricted theories in other branches of philosophy. That is to ignore that both those views have their own problems, too many, and too few objects respectively. What is required is a new approach to developing a restricted view rather than trying to salvage a current theory.

Chapter 5 - Physically Restricted Composition

The physically restricted theory of composition is my attempt to develop a new restricted theory of composition. It is based on what science, in particular physics, tells us about the things scientists study. Physical objects have been studied for thousands of years, and science has been incredibly successful at determining how these physical objects interact and under which conditions what properties the objects possess. Because of this great success I think we should look to science first and once we know what science says about composition, we can try to generalize scientific theories and make a single metaphysical theory. If we have a conflict between what our best science tells us and what our best metaphysical theories require, we ought to accept science over philosophical intuition and argument.

The Case for Science in Mereology

The use of scientific knowledge in the field of metaphysics is commonplace, and rightly so, as any metaphysical theory must be able to account for our scientific observations. Truths of Physics depend on truths of Metaphysics, but in this case we are able to look at the results of our most tested physical theories to help in developing a metaphysical theory of objects. Given two theories, a scientific theory that explains all of our observations, and a metaphysical theory that contradicts one of our scientific observations we would rightly reject the metaphysical theory. The remarkable success of science, and in particular physics, is well established. We are able to live in luxury and largely unconcerned with disease or hunger; we are warm in winter and cool during the summer and have light when it is dark all due to the

successes of science. Our scientific theories may not provide definitive answers to metaphysical questions but based on the results of science we are definitely able to rule out many contenders in metaphysics. In light of this success I intend to see if our physical theories are able to assist in answering the Special Composition Question.

Scientific Background

Currently physicists believe there are four fundamental forces: gravity, electromagnetic, strong, and weak nuclear forces. The only way that two elementary particles can interact is through one or more of these forces. Gravity is the force that acts between massive particles, electromagnetic between charged particles, strong between quarks and gluons, weak between leptons and quarks. When particles interact, we are able to measure how they interact and it is from these interactions that we have developed the notion of forces because once particle seems to apply a force on the other. The terms 'force' and 'interaction' are used interchangeably. These forces can be considered to be rules governing how particles interact. Gravity is the simplest force and the most familiar. The force between two massive particles varies directly with the product of their masses and the inverse of the distance separating them. This description of the way massive particles interact is a description of what we observe in our world. The electromagnetic force is similar but varies as the product of their charge and inversely with the square of the distance. The strong force is unique in that it varies directly with the distance between the particles. This means that the further you pull two quarks apart, the stronger the interaction between the two.

Another key component of our physical theories is that one particle can be bound to another. The hydrogen atom was an example of binding where one particle dominates the motions of another. This need not be the case. Those who are familiar with quantum chromo dynamics (QCD) will recall that quarks are assigned colours based on how they interact with other quarks. There are three colours, red (R), green (G), and blue (B) as well as the corresponding anti-colours anti-red (R*), anti-green (G*), and anti-blue (B*). QCD is a set of rules that describes how quarks act, and how they bind to each other. The quarks are permitted to bind only so long as the colour combination results in the colour white. There are two possible ways to accomplish this.

Allowed Three Quark Arrangements (Baryons)¹⁴

$|R,G,B\rangle$

$|R^*,G^*,B^*\rangle$

Allowed Two Quark Arrangements (Mesons)

$|R,R^*\rangle$

$|G,G^*\rangle$

$|B,B^*\rangle$

These rules are determined by what we observe to occur. They are not based on intuition or speculation. There is the possibility that we are wrong, but it is not likely. This is a quantum mechanical theory; we are more likely to be wrong about general relativity than this. This is not yet empirical evidence for composition.

¹⁴ R – Red, G – Green, B –Blue and the corresponding anti-colours R* - anti-Red, G* - anti-Green, B* - anti-Blue

The evidence for composition comes when we consider what it means for two particles to be bound to one another. A simple account is that one particle determines the other particle's motion, or in the case where there is no dominance the motion of the particles can only be determined by considering the two as a unit. This is done much more formally in physics. Bound states are "states in which a potential prevents a particle from escaping to infinity." (Shankar, 1994) Equations are used to describe the motions of particles, either free or bound. The value of an equation is that one is able to compare the motion of free particles and compare them with bound particles. This allows us to determine what the sharp cut-off is for a particle to become free. An easier example than a quantum mechanical example is to consider the motion of the planets about the Sun. The planets are bound by the Sun, that is, they orbit the Sun; the gravitational potential is such that the planet cannot escape to infinity with the energy available in the system as it is now. The interaction between each planet and the Sun is via the force of gravity. The planets interact with each other as well in this system. How then are we able to say that we can ignore the effects of these interactions and consider only the influence of the Sun? This is not what is meant when I refer to something as 'bound'. I said that the motion of the object is determined (in a dominant way) by the object to which it is bound. The Earth would still move about the Sun along its orbital path without the other planets, the path would be generally the same, though the minor deviations induced by the other planets would be gone. These deviations are commonly referred to by physicists as 'perturbations'. Perturbation theory deals with this aspect of motion. All other influences must be accounted for if we want a precise description of a particle's motion, but these perturbations are several orders of

magnitude weaker than the dominant binding force. The potential well created by the dominant force of the gravitational field of the Sun is so deep that the gravitational forces of all the other planets on the Earth cannot free the earth from the earth's orbit around the sun.

Consider the $|R, R^*\rangle$ meson. In this case no one particle dominates the motion of the other, yet they are in a bound state. In this case it is not the force of one particle on the other that determines the motion of the other. The motion of each individual is determined by the potential that exists between the two. Does this mean we need two different definitions of what it is to have one object bound by the other? No. It is only the fact that the potential between the objects restricts the separation such that it is finite. Consider a single particle bound in one dimension (for simplicity). The following equation gives the condition for that particle being bound in the potential well.

$$-\frac{\hbar^2}{2m} \frac{d^2 \psi}{dx^2} = E \psi$$

Where \hbar is plank's constant divided by 2π , and m is the mass of the particle. E is the particle's energy and ψ is the wave function for the particle.

This is a very precise determination of the energy that the particle requires to become free. The particle will become free only if this energy threshold is reached. The same is true for the Earth. If enough kinetic energy were transferred to the Earth, the Earth's motion would become such that it would no longer orbit the Sun. By adding energy to the system the potential is overcome and the separation could be infinite. This separation need not actually be infinite, but the Earth, if in a motion

away from the Sun would continue on with no limit on the separation because of the Sun. In the case of a hydrogen atom, the electron becomes free when it has energy of 13.6 eV. The electron becomes free of the proton.

The Physically Restricted Theory of Composition

How is this of any relevance to mereology? Consider the neutron, a particle composed of three quarks ($|u,d,d\rangle$). We know they are composite as they decay naturally and because we can split them. The up quark has a charge of $+2/3$, and the two down quarks are $-1/3$ each giving a neutral charge. Fractional charges cannot exist independently in an object. We need the three quarks to compose an object so that we have only integer charges out there in the world. This is not metaphysically necessary, but required by our most verified physical theories. We now have a physically based (rather than intuition based) reason for the category of object. The notion of binding is an obvious contender as a theory of composition I call the Physically Restricted Theory of Composition (PRTC). Two objects compose a third iff they are bound to each other by one of the four fundamental forces.

Physically Restricted Theory of Composition: For any x s, iff they are (physically) bound to each other by one or more of the fundamental forces of nature, then there is a y such that y is composed of the x s.

Notice that I include the phrase fundamental forces of nature as I do not want to rule out the possibility that there are others of which we are unaware. Now that I have proposed my theory I will discuss some advantages and then deal with potential objections.

Advantages

This theory allows us to create many objects out of simples. Protons are composed of their constituent quarks; atoms of protons, neutrons, and electrons. Molecules are composed of atoms. This theory, being motivated by scientific knowledge, is able to deal with any potential natural kind objects. The atoms are bound together to form molecules, which in turn bind together, via the electromagnetic interaction to form things like proteins and other organic objects used to compose cells. The chain continues all the way to astronomical sized objects such as stars and even galactic clusters. We have no bizarre objects of the sort required by UMC.

One might object that there is always a gravitational interaction between massive objects, an electromagnetic interaction between charged objects, so you have the same result as the Universalist. This is not the case. The PRTC requires a bound state exists among the parts. A mere interaction is not enough for composition to occur; there must be a bound state among the parts to compose a whole.

Ship of Theseus

In ship of Theseus cases the scientist can escape the paradox because they are able to precisely describe the case. Where the actual wooden plank of an actual ship is replaced the scientist can deny claim two, that The Ship of Theseus can survive the replacement of a single plank. The planks are not identical at a microscopic or perhaps even macroscopic level. Even if the two planks are physically indistinguishable there are still two planks so the positions are distinct. We may not

be able to tell which plank is which, but there is a fact of the matter. The ship will have a different part after a plank is replaced. In this sense the ship post replacement has different parts so it is not numerically identical with the ship pre replacement. The scientist understands this, but also understands that post replacement it is still a ship remarkably like the original, with the same owner as the original. It fills the same role as the original, taking Theseus and his men where they need to go. Scientists study how an object changes over time and understand that we also use the term 'object' in the sense of two things that are not numerically identical but that have the appropriate causal connection. The scientist could, given this sense of the term 'object' describe this as a case of fission, where The Ship of Theseus does survive the replacement of its parts and becomes two ships. Given the causal history, we can understand how the one ship became two. In this case the scientist does not reject any of the claims and accepts the conclusion, that the one ship became two. There is no magic involved, basically two ships were built, and the process was just a funny one where the parts of one ship were at times mixed with the other. The scientist is not bothered by this because there is a causal history that explains how the process of fission occurred.

Statue and the Clay

In statue and clay cases it is essential that Statue has different properties than Clay. Clay has the property of existing at T_1 and Statue does not have this property so it seems the problem remains. To address the problem and the statue and the clay consider the following cases:

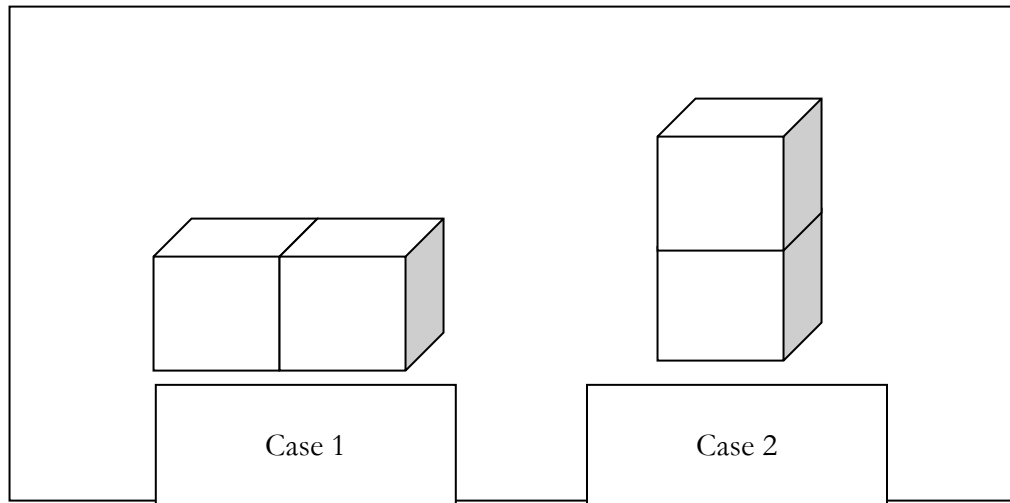


Figure 2

In case one and case two we have 'Clay'. I used the name 'Clay' rather than the more traditional 'Lump' for this example because 'Clay' denotes the parts not the arrangement. In this case I will use the name 'Lump 1' for Clay in case one and 'Lump 2' for Clay in case two. The reason I am doing this is because the solution to the statue and clay paradox is to consider the arrangement of the parts not just the parts. All of the parts in case one are the same parts as the in-case two, yet we can see that in case one Lump 1 has the property being shorter than Lump 2. We have yet to make a statue out of Clay yet we can see that the arrangement of the parts is as important prior to making the statue as it was after. By using the name 'Lump' in the original paradox it was implied that the arrangement was unimportant, a lump will have the same properties no matter its shape. In figure two we see this is clearly not the case.

The arrangement is important because there is a structure associated with composition on this view. The parts are not the only essential components of an object, the interactions among the parts are what cause composition to occur. These

interactions are determined by properties of the parts, things like mass and charge, but also the relative positions of the parts. The bonds between parts change as the relative positions of those parts change. Once relative position becomes a consideration there is a solution to the Statue and the Clay puzzle.

The problem arises because one assumes the object is nothing more than the sum of the molecular parts. The parts of Lump 1 and Lump 2 are the same parts as Clay one assumes. This is not the case in the PRTC. In the PRTC the bonds play an essential role; they are parts of the object. 'Clay' denoted the molecules that are the collection Clay, but the term 'Clay' ignores, as do most people, the bonds that hold the lump of Clay together. The bonds in Lump 1 are not the same as the bonds of Lump two. The two are different objects because they have different parts.

Problem of the Arbitrariness of Undetached Parts

The case of Dion and Theon is an incredibly complex system so I will consider a simpler case, that of a single diatomic molecule Hydrogen (H_2). This is a molecule composed of a two hydrogen atoms connected by single covalent bond. A covalent bond is the sharing of pairs of valence electrons (electrons in the outermost shell of the probability distribution electron cloud). Each hydrogen atom has a single electron orbiting a proton. There are quantized energy states that describe the allowed orbits of the electron. The ground state of the electron orbiting the proton, the lowest possible energy level, is -13.6 eV.

When the two atoms join in a covalent bond the two electrons are shared by the two nuclei, the protons. Each electron is in effect bound to both protons. The repulsive forces of the two electrons can be minimized if the spin states are opposite

($s_1=1/2$, $s_2=-1/2$) and the repulsive force of the protons can be minimized if the two electrons are located between the two protons. The force of attraction of each proton to the two electrons will be greater than the force of repulsion between the two protons in this arrangement. When this happens the allowed energy levels of each electron is now determined by the entire molecular structure, rather than the interaction between the single electron and the single proton. The allowed energy levels of electron one is not the same for the hydrogen atom as the levels for electron one for the hydrogen molecule.

This allows a unique response to the Problem of the Arbitrariness of Undetached parts. The PRTC includes bonds as parts of an object. If we ignored bonds then the hydrogen molecule is composed of two hydrogen atoms, so a hydrogen atom is left when one is removed. The atom was a part of the molecule and by removing it we are left with another hydrogen atom. This cannot be done in actuality as there is also a covalent bond. The molecule and the atoms exist, but so does the bond. Moreover the bond changes each of the atoms so that the atoms before the bond is broken are different that the atoms after the bond is broken (the electrons occupy different energy levels).

The PRTC allows us to accept claim two, that neither Dion nor Theon exist after the amputation. We might not find this attractive as we would like Dion to survive the amputation of his foot. As in the Ship of Theseus case we can consider the change of objects over time and bear in mind the appropriate causal connections. numerical identity of constituent parts might not be required to explain persistence

of personal identity. If we do not need numerical identity then we, given the correct causal connection, could claim that Dion exists and Theon does not.

Problem of the Many (Unger, 1980)

The problem of the many can be solved by considering how physicists treat composite objects. The solution is to deny that the cloud is an object. Clouds are not the sorts of things that exist as objects because there is no bound state that exists for the molecules that we say, incorrectly, compose the cloud. The phenomenon of a cloud is real; it is the visible mass of water droplets or ice crystals suspended in the Earth's atmosphere. The cloud is visible because there are enough water droplets in a given volume of the atmosphere refracting the Sun's light as to be noticed, but there is no bound state among these droplets, so no object.

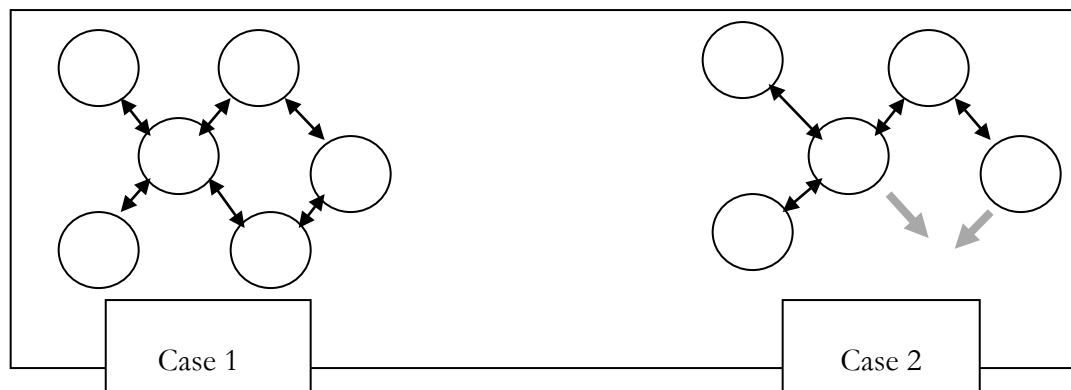


Figure 3

In figure 3 I have illustrated the case of a composite object before (case 1) and after (case 2) it loses an atom. The atoms are indicated by the circles and the bonds between the atoms are indicated by the arrows. The grey arrows indicate the bonds which no longer exist in case 2. The bonds are an essential component of the composite object as we could have all the atoms of the object and still no composite

object if there are no bonds. These bonds are an interaction between atoms and because they are an interaction they are all current at all times the composite object exists. The composite object in Case 2, strictly speaking, does not exist and while the composite object in case one exists. The bonds that occur change the structure of the atoms of the composite object in case one such that when the atom is taken from the composite object in case 1, it is not the same object as the proper part of the object in case one minus the atom, but a close approximation of that proper part that remains.

The bonds between the parts are an essential element of the composite whole; they are parts of that whole. When we look at the composite whole at the microscopic or the macroscopic level it is the bonds between the parts that science has shown are of greatest importance. We can have the whole without the bonds but consider these wholes to be merely arrangements rather than composite objects. It is only in cases where the bonds are present that science considers a composite whole to exist. Emergent properties result from these bonds. There is no problem of the many because there are no equally good cloud candidates. If there is a bound state among some parts it will be well defined, so there is no question as to which parts have entered into the composition relation, composing that particular object.

Consider a heap of sand in the desert, commonly referred to as a dune. The problem of vagueness relating to the boundaries of a dune all result from the fact that the dune is not an object. Our imprecise language is such that we treat in some instances, objects and arrangements interchangeably. There are no bonds holding the parts of the dune together. There are inter-sand grain gravitational forces, but

these are not sufficiently strong to form a bound state. If you tried to pick up the heap by pulling on only part of the heap's constituent sand you would not pick up the heap. The inter-sand particle attraction cannot overcome the force of the Earth's gravity and it is in the Earth's gravity, so in this external field the heap is not in a bound state. Were the same heap in an area of extremely low external gravity the inter-sand particle gravitational forces would be great enough to form a bound state and the heap would be an object. The grains of sand are held in place by the earth's gravitational field and friction between the grains. Because they are held in place by the earth the sand grains appear to compose an object, but given greater scientific analysis we see the dune is merely an arrangement not an object. Arrangements may be vague because of our use of language to denote these arrangements. By use of the word 'dune' we imply in general a collection of sand grains not a specific arrangement. If we are being specific in our use of the word 'dune', even pointing and saying that dune over there, there is still an imprecision because the arrangement is vague. In the case of objects there is a fact of the matter, the bonds between the parts determine if composition is occurant.

Coordinated Action

This theory has the distinct advantage of allowing for coordinated action. By allowing for complex structures such as neural networks, electronic or biological, intentional states and action on those states is possible.

Objections

The question remains, if I am able to have all the types of ordinary objects we want. The potential problem lies in artifacts, not natural kinds. Clearly I will get

things like atoms, molecules, rocks. Consider the pyramids. They are constructed of blocks of rock arranged in the shape of a pyramid. Here is a potential problem as there is no bound state for these rocks. They exist as they do because of the earth's gravitation not the inter-block gravitational forces. The inter-block force that does hold the pyramid together is friction, not a fundamental force. This force of friction is also due in large part to the gravitational force pulling down on each block and the normal force acting on each block above by the block below. The blocks forming the pyramid and the earth compose an object, because there is a bound state for the pyramid-Earth system because of the interaction between the earth and each block, so it seems to us that the pyramid is an object so we can explain why our perceptions differ from the explanation in this case. The imprecision of our language, because of the imprecision of common usage is what has led us to treat arrangements and objects with the same grammatical structure. It is this imprecision to which the common sense Mereologist falls victim. Common usage in our language is fine so long as scientists and philosophers recognize the limits of this common usage.

Gunk – Not a Problem

In the event that gunk does indeed exist, I think that my theory does accommodate its existence. All that PRTC requires is that the constituents of an object be bound by a fundamental force of nature. There could be even an uncountably infinite number of constituent particles that constitute what we would consider a rather small object, yet so long as they are bound together by some force PRTC allows for this.

Perception of Objects

The obvious objection to this view is that while it may pick out microscopic objects, it conflicts with our intuitions regarding macroscopic objects. We do not consider the Earth-Moon system to be an object. In this case I will call into question your intuitions. Our intuitions are based on our perceptions. We are wrong to think that our perceptions carve nature at its joints.

We see stars in the night sky and given a telescope we even see galaxies, nebula to other beautiful visions. We do not interact with these objects directly other than to our limited vision. Given this limited interaction and given a physical theory that works we ought to choose the physical theory over any common sense intuitions based on our limited experience.

The Truths of Science are Contingent

The so called truths of science are contingent on being in the world in which these rules apply. Metaphysical truths transcend possible worlds so to base mereology on truths of physics is not possible. “I can imagine a world very much like our own but where _____ is not true” is usually how these sorts of objections begin. Chalmers did this sort of thing in his zombie argument (Chalmers, 1996) against Functionalist theories of mental intentional states. The specific objection in this case should be that there is a world very much like our own where there are no bonds between parts. There are merely arrangements, though things appear very much as they do in our world. This world still has all the ordinary objects as our own world with each object possessing the same macroscopic properties as in our world.

Until you can provide a description that includes an explanation of how this world is able to be macroscopically identical to our own without the same micro properties and structures you have not conceived of this world. Until you are able to give this explanation there is no reason to suspect that such a world could exist as it seems clear from the solution I provide to the problem of the many, the bonds are an essential feature of the object. I do not think that the description provided in these cases is consistent. You must provide a solution to the problem of the many that does not utilize bonds within the structure of the parts in this strange world.

Nails, Screws, and Friction

Friction fasteners, for example nails and screws, hold together many of the artifacts we create. Consider two pieces of wood joined by a single screw. The two pieces of wood are both objects as is the screw, but are the three objects, the wood and the screw, composing a fourth object composed of those parts? According to the PRTC they are not as friction is not a fundamental force of nature. “The cause of friction is that surfaces, however smooth they may look to the eye, on the microscopic scale have many humps and crest.” (Isaacs, A Dictionary of Physics, 1996) This causes a resistance to motion not a bond due to an interaction through one of the fundamental physical forces. The two pieces of wood held together by the screw do appear to have all the macro properties of a composite object but do not have the essential property at the micro level of being in a bound state with each other due to a fundamental physical force. There is the option of easing the requirement that the force be a fundamental force of nature and allowing the force of friction to bind objects. The force of friction is the normal force multiplied by the coefficient of friction. The problem is that this will not solve the next objection.

Biology

Biology is the science which studies living things. Everything from viruses to large mammals is included in this field. If we consider a single cell or something as large as a person there is a situation that poses a problem for the PRTC, that of water or other fluids contained in the organism but not bound by a fundamental physical force. The chemist still has bonds that are due to electromagnetism forming between atoms and molecules, but the cytoplasm contained in a cell or the blood contained within your body is not bound by any fundamental physical force. The fluid stays trapped because the size of the molecule is larger than the gap in the molecular structure of the cell wall. The cells themselves bind to each other through a chemical process involving so called, cell-adhesion molecules (Integrating Cells into Tissues -- Molecular Cell Biology -- NCBI Bookshelf, 2010), so there is a fundamental force involved in binding the cells to one another to form tissues. There is not this same force keeping the blood within your veins.

We could say that the trapped fluid is not a part of the object only the parts bound due to fundamental forces are a part of the object but this is undesirable for two reasons. First, the macro properties of the object include properties that the trapped fluid provides; the mass of the fluid is typically counted along with the mass of the other parts. The size of the cell is due to the pressure of the trapped fluid holding the cell wall at a certain diameter so this property is due to the trapped fluid. The second reason to suppose the trapped fluid is a part of the cell is that is essential to the biological functions of the object. The cell could not function without the trapped fluid. Indeed, when the water is removed the cell dies, that is all biological functions stop. The same is true of us and our blood. It is essential that the blood

within us transports the required molecules to the cells within our body. It is the cells within the blood that transport the molecules but these cells could not flow within our veins without the liquid. Perhaps we are best to look for a solution based on what it is to be bound rather than a solution based on binding.

Chapter 6 - Spatially Restricted Composition

The Spatially Restricted Theory of Composition is an attempt to preserve all the benefits of the Physically Restricted Theory, while correcting for the defects. The PRTC was an attempt at a solution based on the notion of binding between objects. The SRTC is based on the notion of what it is to be bound by other objects. This distinction is a subtle one but important. Binding is an interaction between objects such that the separation must be finite; while being bound is a condition on separation such that it must be finite, without the requirement of an interaction. An object is bound by another iff the distance between the two is such that the distance between them must be finite. This allows for cytoplasm, trapped within the cellular wall, to be bound within the cellular wall. The cytoplasm is not itself an object as it is a liquid composed of unbound molecules but each of those molecules is bound within the cell.

Spatially Restricted Composition – For any x s, iff there is a relation, other than the composition relation, that places a restriction on the distance between the x s, such that the distance between the x s is necessarily finite, there is an object y that is composed of the x s.

This theory captures the part of the PRTC that works, the restriction on separation, without the requirement of fundamental physical forces causing that restriction of separation that failed in the PRTC. By allowing fundamental physical forces to be augmented by other causes to restrict separation the Spatially Restricted Theory of Composition will be able to accommodate artifacts that are held together by things other than the fundamental physical forces. It will also accommodate natural kind

objects like humans, who have blood and other bodily fluids as parts. It will lastly, allow explanations of why the objects allowed by this theory should exist, even if they are objects that offend common sense.

The following case is illustrative of how the special composition question can be answered when accepting the SRTC. Consider a bottle filled with water and the lid securely fastened to the bottle. The water is unable to escape the bottle because the water molecules are larger than the gaps in the molecular structure of the bottle and the lid. The gap between the lid and the bottle is also smaller than the water molecules. The water is contained in the bottle. The contained in relation is one that indicates a restriction on the separation of the water molecules from the bottle. Specifically, the water molecules must remain within the confines of the bottle. The water molecules, the bottle and cap compose an object under SRTC.

This example accords with common sense intuitions about the bottle of water being a single object. Assume the bottle in this example is of the ordinary plastic type commonly used to distribute water and that the water molecules are in a liquid state. The bottle of water (BOW) object has properties that the water molecules and the bottle do not have independently of each other, for example if I can toss BOW to you. I can toss the bottle to you also, but would have difficulty tossing the water molecules to you, unless they were frozen into a block of ice. If I throw BOW at you, you will not be wet. If I throw the water molecules at you, then you will be wet. If I pour the water molecules from BOW the contained in relation is no longer true of the molecules and the bottle, so BOW ceases to exist. The

molecules no longer bear a relation to the bottle that restricts separation so the molecules of water, the bottle and cap no longer compose an object.

Once the water is poured from the bottle the separation of the molecules of water and the bottle is restricted by the on the same planet as relation, but that is a relation between the water molecules, the bottle, and the Earth. The water molecules, the bottle and the Earth compose an object without the existence of BOW. The contained in relation that allowed us to identify BOW as an object was not what caused composition to occur. It was what allowed us to identify that BOW was an object. The fineness of the molecular structure of the bottle surrounding the water molecules that are larger than the gaps in the structure of the bottle is what caused composition to occur in this case.

Now consider some large objects, the Earth and the Moon. Common Sense Mereologists accept that each of these individuals is an object and that they are distinct. They would probably not accept that the Earth and the Moon compose a third object due in large part to the great distance separating the two. The trip to the moon is not an easy one. The obvious response is that it is not any easy voyage across the Atlantic Ocean from France to Canada. Here the Common Sense Mereologist responds that the land is actually joined under the ocean. I counter, that the land is not joined in the sense of conjoined twins, and rather there are tectonic plates like rocks resting against each other composing the solid portion of the earth. They stay close together, counters the Common Senser. This is where they are starting to accept the Spatially Restricted Theory.

The Moon orbits the Earth is what we are told in school. The Moon does orbit the Earth, but only because the center of mass of the Earth-Moon System is located inside the crust of the earth. The earth is actually orbiting this center of mass as part of the Earth-Moon System as well. When the Earth orbits the Sun it is the center of mass of the Earth-Moon System that orbits the center of mass of the Solar System, not the center of mass of the Earth orbiting the center of mass of the Sun. This hold true for even larger systems, the Solar System and the Galaxy, etc... There is a small but measurable difference. It is this difference, ignored by most people most of the time that is essential in understanding what follows.

The Earth-Moon System acts as a single object when orbiting the Sun. When we do calculations (Barger & Olsson, Classical Mechanics: A Modern Perspective Second Edition, 1995) to figure out the orbits of systems like the Earth-Moon System orbiting the Sun we treat the Earth-Moon System as a single object at its Center of Mass¹⁵ with mass of the Earth and the Moon. We treat the system as a single object. Do we do this because the physics works out, or does the physics work out because the Earth-Moon System is an object? Physicists are in the business of studying objects. They describe the properties of objects and try to explain how they interact, change, come into existence and cease to exist. Physicists develop theories based on evidence, and in this case there have been hundreds of years of evidence confirming Newton's theories, so much so they are commonly referred to

¹⁵ To be completely correct, the center of mass is equally accurate as the center of gravity in this case as the force of gravity acts through the center of mass but this is not true of all forces. In cases where other forces are involved, it is the force centers that must be used.

as Newton's Laws. The fact that the Earth-Moon system acts as an object when it interacts with the Solar System, according to our best physical theories, is motivation for thinking that the Earth-Moon system is an object. The universalist, from chapter 3, could offer a similar defense of the strange objects entailed by that theory. If we can give an explanation that motivates accepting strange objects into our ontology for either SRTC or Universalism then we need to look at the relative merits of the theories and the motivations for accepting these strange objects to choose between the theories, if both theories are otherwise equally satisfactory. The strange objects of Universalism are stranger than those of SRTC so the universalist has work to do.

The Moon orbits the Earth, where orbits is the relation restricting the separation of the moon from the earth. There is a relation that restricts the separation of the parts for this case so we have an answer to the Special Composition Question and an explanation for why the Earth-Moon System is an object, even though our everyday experience does not indicate to us that it is. The composition is caused by the force of gravity exerted between the Earth and the Moon. The energy in the Earth Moon system is sufficient that the moon maintains its orbit. There would have to be an increase in the kinetic energy of the moon to free it from orbiting the Earth. Unless this energy is added the Moon will remain in orbit, thus composing an object, the Earth-Moon System. This case demonstrates that the benefit of the PRTC, where the binding is an interaction due to fundamental physical forces, is still allowed by the SRTC.

Advantages

The Spatially Restricted Theory of Composition gives us a simple and restricted solution to the Special Composition Question that gives us all the ordinary objects we are used to. We can have people, tables, chairs, homes and all the other ordinary objects we are used to. Nails, screws and other friction fasteners are no longer a concern as there is now no requirement the reason for a restriction on separation be a fundamental physical force. Friction may be the reason the separation is restricted, the restriction on separation is the only requirement. The relation that restricts the separation may not always be easily identified, and may be quite complex, but it is not precluded from existing for any ordinary physical object because of the SRTC. The ordinary objects are objects and not by stipulation. In cases where objects result that seem strange, the SRTC allows scientific explanations to explain why these strange new objects are objects. This is a significant advantage over brutal composition as there is a reason that some things are composite objects and others merely composite arrangements. It is also an advantage over the other restricted theories presented in chapter four because we do not have to rely on our intuitions about what composite objects are to form a serial type response.

The SRTC also handles the objections that other theories cannot.

Ship of Theseus

In Chapter 5, a solution covered cases where there was a clear case of binding, the planks would have to be glued together to solve the problem. With the SRTC the planks can be held together with friction fasteners, tied together, nailed, screwed, or fasted by any means that placed a restriction on separation and we still have a

solution. We deny claim two, that The Ship of Theseus can survive the replacement of a single plank. We may not be able to tell which plank is which, but there is a fact of the matter. The ship will have a different part after a plank is replaced. In this sense the ship post replacement has different parts so it is not numerically identical with the ship pre replacement. Post replacement the ship is still a ship remarkably like the original. It fills the same role as the original, taking Theseus and his men where they need to go. Objects change over time and we understand that we also use the term 'object' in the sense of two things that are not numerically identical but that have the appropriate causal connection. Given this sense of the term 'object' we describe this as a case of fission, where The Ship of Theseus does survive the replacement of its parts and becomes two ships. Given the causal history, we can understand how the one ship became two. In this case we do not reject any of the claims and accept the conclusion, that the one ship became two. We are not bothered by this because there is a causal history that explains how the process of fission occurred. There is no magical process; this is still a clear case of fission.

Statue and Clay

The statue and clay problem is solved exactly the same way as it was in the PRTC. The only thing that has changed is that we now allow bonds that are caused by things other than the fundamental forces of nature. The term 'Clay' denotes only the molecular parts, not the bonds that are an essential part of Statue. All the molecules are shared by Statue and Clay, the bonds are also shared but they are an essential part of Statue and not of Clay.

Problem of the Arbitrariness of Undetached Parts

This is not a problem given the SRTC. We can still resort to the changes in structures caused by physical interactions. We may not have only changes in allowed energy levels for electrons to look for but these still apply in cases that are covered by the PRTC. For the new cases covered by the SRTC but excluded by the PRTC we have forces involved that are not fundamental forces of nature. These secondary forces include friction. Consider a case where a screw holds two pieces of wood together. We can look at the molecular structure of the screw and the wood to determine if they are the same when the screw holds the wood together as they are when the three pieces are separate.

It turns out that it is not this simple as a large component of the force of friction comes from so called “third party” (He, Müser, & Robbins, 1999) molecules. Given this complexity I will simplify and ignore this role. The wall molecules, the outermost molecules on each piece of the wood interact with the wall molecules of the screw. This is not an interaction in the sense of bonding via a fundamental force; rather they push against one another resisting motion due to the unevenness of the surfaces at the molecular scale. This force is not present when the wood and screws are separated. This is a measurable way to tell the two apart. The case where the screw holds two pieces of wood together the force on the screw is greater than the force applied to bind the screw to a single piece. The arbitrary undetached part of the wood with the screw is not the same as it is when the second piece of wood is attached as after the second piece of wood is gone.

Problem of the Many

The bonds between the parts are an essential element of the composite whole. This was an essential element of the PRTC and remains a part of the SRTC. The term 'bond' has been expanded to include things that are not fundamental forces, such as friction and containment, so we must now show there is no problem with these new types of bonding.

Consider a heap of sand in the desert. We did just this in chapter five. A heap is a vague thing as there are no clear demarcations. We were able to disregard the vagueness of heaps and the like because they were not objects according to the PRTC. We must now show that this still remains the case for the SRTC. The grains of sand are subject to a force of friction and it is this force that holds them together in the heap. So far this is not promising as it seems we have a clear case of a vague object. There is a force between the grains that holds them in place.

Consider an easier case that of a pyramid built of uniform stones. The first course of stone rests on the earth and does not move because of the static friction between the stones and the earth. The weight of the stones is opposed by the equal and opposite normal force exerted on the stones by the earth. The static friction opposes lateral loads placed on the stones. The second course is placed atop the first. The weight of these stones is opposed by the normal force of the first course acting on the second course. The static force of friction between the second and first course opposes lateral motion of the second course of stones. Here we can see a difference. The force of friction that kept the first course from lateral motion is between the earth and the stone, not merely the stones. The pyramid requires one of

these binding forces to be between it and the earth. The pyramid is not an object independent of the earth because one of the binding forces required is a force between the parts of the pyramid and the earth. Our definition of the SRTC requires that the binding forces exist between all and only the parts of the whole. The same will be true for heaps and other vague arrangements. They will require some external participant to keep them fixed in their arrangement.

People are Objects, and Sometimes People are Just One Object

Peter van Inwagen wanted to ensure that living things were objects as there were emergent properties that the nihilist could not reduce to arrangements of simples. On my account a person is an object, though not because of the emergent property of thought. It is solely because of the restriction on the separation of the physical parts that the SRTC calls for people to be physical objects. Personal identity is not a requirement. People are different from rocks and other inanimate objects due to biological reasons, but not because they are objects and rocks are not. There is no ad hoc requirement to allow people to be composite objects.

Another consequence of the SRTC is that if, as in van Inwagen's example two people who are holding hands find themselves to be unable to release one another's grip, then they form a single composite object. They remain distinct people, but form a single composite object. This may be initially objectionable, but can easily be explained away. Consider a case of conjoined twins with shared body.¹⁶

¹⁶ These cases are extremely rare. See Time Magazine 25 Mar 1996

<http://www.time.com/time/magazine/article/0,9171,984307,00.html>

The twins each develop their own personalities, emotions, experiences, and have two distinct streams of consciousness. They are two distinct people who happen to share the same body. The twins are two people with one body. They are one object. The SRTC allows for this single object to be two people which is a benefit in the case of conjoined twins. It should also be acceptable then, that two people who find themselves unable to let one another go compose an object.

A third benefit not open to van Inwagen, is that the question of what constitutes a life remains a question of biology. The Life Proposal required that the issue of what constitutes a life be entangled with mereology. Life was a property or process that also added the mereological property of being a composite object. SRTC does not conflate the distinct fields of biology and mereology.

Conclusion

The objective of this thesis is to develop answer the special composition question for all cases involving concrete objects. The competing theories were unable to simultaneously resolve the problems of material constitution while at the same time answering the special composition question. Having reviewed the competing theories and the failing of each of these, I developed two new theories based on physical theories of composite objects.

The Physically Restricted Theory of mereological composition was able to solve most of the problems of material composition, including the problem of the many, but was unable to account for living material beings because of the fluid contained within. It was also unable to resolve situations where paradigmatic cases of composite objects were held together by non-fundamental physical forces, friction fasteners for example.

These two objections motivated my development of the Spatially Restricted Theory of mereological composition. This theory was based on the essential aspect of the PRTC, that the parts of an object compose the whole when the separation between the parts is restricted because of only the parts. This took what I consider to be the essential feature from the PRTC but did not rely on fundamental physical forces to restrict the separation of the parts. This solved the problems of friction fasteners and fluids (and solids, gasses and plasmas for that matter) contained by containers, including living beings.

Nihilism suffered from the inability to account for living beings without resorting to *ad hoc* exceptions being made in the case of living beings. Given that

living beings are composite if this *ad hoc* exception is made, then the nihilist cannot resolve any of the problems of material constitution for living beings.

The Universalist is able to solve many of the problems of material constitution but is forced upon the horns of a dilemma. The Universalist must contend that there is only one object composed of a particular set of parts, and that the properties of the object change base of the arrangement of the parts, though the object remains the same, or that the parts of an object will always compose some object, though the objects may be different based on the relative positions of the parts. In the first case the problems of material constitution are not solved, they become problems to do with arrangements rather than objects. In the second case there is no guarantee of a sharp cutoff between one object becoming another, so there is metaphysical vagueness. There is a third problem as there are simply too many objects. Were the theory able to solve the problems of material constitution and answer the special composition question we could begrudgingly accept too many objects as a cost, but since Universalism does not definitively solve these problems we should not accept the consequence of too many objects.

The restricted theories discussed included contact, fastenation, weak fastenation, n-fastenation, weak fastenation with degrees, all of which failed to resolve the problems of material constitution and answer the special composition question. Markosian's brutal view does answer the special composition question by saying there is a fact of the matter but does not offer any hope that we will ever find an answer to the problems of material constitution. Given the limited value of such

a response to the special composition question, the brutal view should only be accepted after exhausting all other possibilities.

The PRTC is my attempt at just such a possibility. By looking at the successful approach physics has taken in the study of material objects I was able to conclude that we consider composite objects to be objects because they have properties that the parts do not (emergent, rather than location). The key cause of this composition was that the fundamental forces restrict the separation between the parts such that this separation must be a finite distance. This seemed to be a logical candidate answer to the special composition question. It did not solve two problems of material constitution, that of living beings and the cases where the separation was restricted for reasons other than fundamental physical forces. These were both cases where there appeared to be composite objects because of the emergent properties, for which the PRTC could not account.

The SRTC solved the problems of living beings and the composition due to reasons other than fundamental physical forces objections while providing an answer to both the general and special composition question, and the problems of material constitution. Given this success it is currently the best solution to the General and Special composition Question.

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