Open Access Dissertations   Electronic Theses and Dissertations

2019-07-22

Metaphysical Grounding and Property Theory

Wei Huang
University of Miami, huanwe@gmail.com

Follow this and additional works at: https://scholarlyrepository.miami.edu/oa_dissertations

UNIVERSITY OF MIAMI

METAPHYSICAL GROUNDING AND PROPERTY THEORY

By

Wei Huang

A DISSERTATION

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Doctor of Philosophy

Coral Gables, Florida

August 2019

UNIVERSITY OF MIAMI

A dissertation submitted in partial fulfillment of
the requirements for the degree of
Doctor of Philosophy

METAPHYSICAL GROUNDING AND PROPERTY THEORY

Wei Huang

Approved:

_____
Brendan Balcerak Jackson, Ph.D.
Assistant Professor of Philosophy

_____
Simon J. Evnine, Ph.D.
Professor of Philosophy

_____
Elijah L. Chudnoff, Ph.D.
Associate Professor of Philosophy

_____
Guillermo Prado, Ph.D.
Dean of the Graduate School

_____
D. Gene Witmer, Ph.D.
Associate Professor of Philosophy
University of Florida

HUANG, WEI   (Ph.D., Philosophy)
<u>Metaphysical Grounding and Property Theory.</u>   (August 2019)

Abstract of a dissertation at the University of Miami.

Dissertation supervised by Professor Brendan Balcerak Jackson.
No. of pages in text. (110)

The purpose of this dissertation is to offer an account of metaphysical grounding based on property theory. In Chapter 1, I explain the motivation behind the project. In Chapter 2, I propose a property theory, and argue that true real definition statements show property constitution. In Chapter 3, I relate true grounding claims with true factive real definition statements. This suggests that defining metaphysical grounding in terms of property constitution and property instantiation might be promising. To carry out the project, I define the notion of determinant assignment on the basis of the property theory proposed in Chapter 2. Then, I offer an account of metaphysical grounding by appealing to the notion of determinant assignment and its factualization. Since these two notions can be defined in terms of property constitution and property instantiation, metaphysical grounding can also be defined in terms of property constitution and property instantiation. With my account of metaphysical grounding, in Chapter 4, I argue that metaphysical grounding is a strict order, and that both the entailment principle and the internality principle are false. Finally, I address the meta-grounding problem.

To my parents, Guozhi Huang and Jie Dong

ACKNOWLEDGEMENTS

PREFACE

The notion of metaphysical grounding attracts increasing interest among contemporary metaphysicians. It is partly because some finer structure can be found in the modal characterization of the world, and partly because Quinean ontology does not address some significant metaphysical questions.

In addition to that, an account of metaphysical grounding enables us to understand the role played by philosophical inquiries as against all other inquiries.

Personally speaking, my interest in the notion of metaphysical grounding also stemmed from the desire to respond to the Communist Party of China's rejection of universal values. In this dissertation, I say nothing about what the notion of universal value is, whether there are universal values, and whether what we take as universal values are really universal. However, I believe that the account of metaphysical grounding proposed in the dissertation helps to answer these questions.

TABLE OF CONTENTS

Chapter 1: Introduction

The ultimate goal of this dissertation is to define metaphysical grounding in terms of property constitution and property instantiation. In chapter 1, I want to explain the motivation behind the project. I will argue that there are reasons to take seriously the question: if the notion of metaphysical grounding is definable. Then I will mention a few methodological issues.

The following notions are *prima facie* connected: real definition (Rosen, 2015), essence/nature (Fine, 1994a; 1994b), metaphysical grounding (Correia & Schnieder, 2012; Fine, 2012; Raven, 2012; Rosen, 2010), metaphysical determination (Audi, 2012), metaphysical explanation (Litland, 2015; 2017), fundamentality (Bennett, 2017; Koslicki, 2015; Wilson, 2014), ontological dependence (Correia, 2008; Fine, 1995; Koslicki, 2012), and truth-making (Rodriguez-Pereyra, 2015). Take Fine's (1994a) often-quoted example, we can illustrate their connection as follows:

(a) To be the singleton {Socrates} is to be the set having Socrates as its sole member.

(b) It lies in the essence/nature of {Socrates} that it is a set having Socrates as its sole member.

(c) The fact of there being Socrates grounds the fact of there being {Socrates}.

(d) The fact of there being Socrates determines the fact of there being {Socrates}.

(e) The fact of there being Socrates explains the fact of there being {Socrates}.

(f) Socrates is more fundamental than {Socrates}.

(g) {Socrates} ontologically depends on Socrates.

(h) The fact of there being Socrates makes the sentence "there is {Socrates}" true.

(a) is a real definition statement; (b) is an essentialist claim; (c), (d), and (e) are claims about metaphysical grounding, metaphysical determination, and metaphysical explanation repectively; (f) and (g) are about relative fundamentality and ontological dependence; and (h) is about truth-making.

(In the above examples, I assume that facts are relata of metaphysical grounding, metaphysical determination, metaphysical explanation. That is exactly Audi's (2012) view. For the current purpose, it is legitimate to do so because I do not want to enter into detailed discussions about these notions, but to illustrate the connection between them. I do not hereby deny that there are different understandings of these notions.)

I will call these notions "grounding-related notions." Of course, there are many other grounding-related notions, for example, generalized identity, reduction, substancehood, primitiveness, bruteness, derivativeness, etc.

Obviously, grounding-related notions resemble each other in respect of being grounding-related. Hence, they form a family. But there are also noticeable differences among them. For example, the truth-making relation relates facts to

true sentences; however, metaphysical grounding relates facts to facts (Fine, 2012).

At this juncture, some may settle on the family of grounding-related notions, while others may take one of them as more fundamental and try to define some other notions in terms of the more fundamental one.

For example, in view of the similarities and differences between truth-making and metaphysical grounding, Koslicki (2015) argues that it is rational to believe that truth-making and metaphysical grounding are merely unified by family resemblance. On my view, that is definitely true. However, she does not proceed to consider whether truth-making can be defined in terms of metaphysical grounding or some other grounding-related notions.

In contrast, Rosen defines real definition in terms of metaphysical grounding, which is expressed by the phrase "in virtue of" here:

> For Φ to define F just is for it to be the case that necessarily, when a thing is F or Φ, it is F or Φ in virtue of being Φ (Rosen, 2015).

Both Audi and Fine define metaphysical grounding in terms of essence/nature:

> To label this relationship, let us say that facts are suited to stand in a relation of grounding only if their constituent properties are essentially connected (Audi, 2012).

> Thus the particular explanatory connection between the fact C and its grounds may itself be explained in terms of the nature of C (Fine, 2012).

And Correia and Skiles define essence/nature and metaphysical grounding in terms of generalized identity, which is close to, but not the same as, real definition:

We analyzed partial essence, recall, in terms of conjunctive parthood, which was defined in terms of generalized identity. We now propose to analyze grounding in terms of another parthood relation—disjunctive parthood—which we analyze in an analogous fashion, invoking disjunction instead of conjunction (Correia and Skiles, 2017).

No doubt, one might feel unsatisfied with one or another of these particular projects. However, I believe that the general project of defining one grounding-related notion in terms of another is promising and can be more fruitful than settling on the family of grounding-related notions. And, one does not have to agree with any particular project to see that.

Once the project is fully carried out, it can be expected that we will have one or more grounding-related notions in terms of which all other grounding-related notions are defined, or a family of mutually defined grounding-related notions.

In the former case, it is natural to wonder if those more fundamental grounding-related notions can be further defined. If they can be further defined, then they are not primitive; if otherwise, they are plausibly primitive notions. In the latter case, it is natural to wonder if the family of mutually defined grounding-related notions can be defined in terms of notions not in the family. If they can be so defined, then the family *as a whole* is not primitive (Fine's (1994b) notion of reciprocal essence applies here); if otherwise, the family *as a whole* is primitive.

At this juncture, some may take some grounding-related notion (or the family of grounding-related notions) to be primitive; while others may take some grounding-related notion (or the family of grounding-related notions) not to be primitive.

So far, most authors in the literature either explicitly claim that some grounding-related notion is primitive, or temporally assume that some grounding-related notion is primitive:

> Grounding is an unanalyzable but needed notion—it is the primitive structuring conception of metaphysics (Schaffer, 2009).

> For reasons that I have already given in my paper "Essence and Modality," I doubt whether this or any other modal explanation of the notion can succeed. Indeed, I doubt whether there exists any explanation of the notion in fundamentally different terms (Fine, 1994b).

> We should grant immediately that there is no prospect of a reductive account or definition of the grounding idiom: We do not know how to say in more basic terms what it is for one fact to obtain in virtue of another. So if we take the notion on board, we will be accepting it as primitive, at least for now (Rosen, 2010).

Nevertheless, taking a grounding-related notion as primitive has demerits. Let us say, metaphysical grounding is primitive. The first demerit is that primitive metaphysical grounding might be dismissed as murky (Daly, 2012). Even if one grasps particular cases of metaphysical grounding, one might still feel the term of art unclear.

Second, if metaphysical grounding is primitive, then the relation between metaphysical grounding and small-g relations becomes elusive. It is difficult to answer why all small-g relations underwrite metaphysical grounding. Here, small-g relations (Wilson, 2014) include set membership, the part-whole relation, material constitution, functional realization, the determinable-determinate relation, etc, which are supposed to be more specific than the grounding relation.

Third, if metaphysical grounding is primitive, then one has to take metaphysical grounding's having the formal properties that it actually has as

brute facts. For example, if metaphysical grounding is in fact transitive, then one has to take metaphysical grounding's being transitive as a brute fact. If metaphysical grounding and conjunction are both primitive, then one has to take the principles governing the interaction between metaphysical grounding and conjunction to be brute. For example, a conjunctive fact is grounded in its conjuncts. (Fine (2012) call the above principles "the pure and impure logic of ground.")

Finally, if metaphysical grounding and the family of modal notions are both primitive, then one has to take the principles governing the interaction between metaphysical grounding and the family of modal notions to be brute.

To be clear, I do not think that the above constitute good arguments against primitive metaphysical grounding. After all, people continue to take identity as a primitive notion, even if that makes Leibniz's Law a brute principle. I would rather take it as motivation to take seriously the question: if metaphysical grounding can be defined in terms of notions not in its family.

As we will see later, my proposal is that metaphysical grounding can be defined in terms of property constitution and property instantiation, which are not *usually* seen as grounding-related notions. With this account of metaphysical grounding, I am able to take the above-mentioned principles as derivative.

(Of course, if metaphysical grounding and property constitution both belong to a somewhat different family of building relations (Bennett, 2017), then I actually define one building relation in terms of another building relation.)

In the dissertation, I take a detour before offering an account of metaphysical grounding: I start with real definition statements and then turn to metaphysical grounding. There are two reasons to do so.

First, real definition statements admit of less variation than essentialist claims and grounding claims. Hence, starting with real definition statements is more manageable than starting with essentialist claims or grounding claims. For example, corresponding to the real definition statement (a), we have (b) as well as the essentialist claim "it lies in the essence/nature of {Socrates} that it is a singleton." Corresponding to the real definition statement "to be jade is to be nephrite or jadeite," we have both "the fact of a's being nephrite grounds the fact of a's being jade" and "the fact of b's being jadeite grounds the fact of b's being jade" (under the assumption that a is nephrite and b is jadeite).

Second, as is shown by (f) and (g), claims about relative fundamentality statements and ontological dependence can leave out specific small-g relations. In contrast, the corresponding real definition statement (a) makes reference to set membership, one of small-g relations. Hence, real definition statements are richer in content. I believe that starting with real definition statements makes us better equipped to understand the relation between metaphysial grounding and small-g relations.

At the end of this chapter, I want to discuss some methodological issues. I have previously mentioned a few demerits if we take metaphysical grounding as primitive. That is, a few principles governing metaphysical grounding will be rendered brute. In the dissertation, I will respect these principles as much as I

can because it is these principles that guide our attempt to account for metaphysical grounding. Even though I depart from the orthodox entailment principle in the end, I still try to find some connection between my account and the entailment principle.

In my attempt to account for metaphysical grounding, I will also appeal to our intuitions about many other grounding-related notions, which are left undefined in the dissertation. On my view, this is legitimate because the attempt to account for metaphysical grounding should be guided by our intuitions about other grounding-related notions.

In addition, I will go over a few examples of real definition and metaphysical grounding in the dissertation. They are plausible examples, but I do not want to be dogmatic about them.

For example, I take "to be Socrates is to be the human being with such-and-such an origin" to be a true real definition statement. But a priority monist may claim that to be Socrates is to be such-and-such a part of the whole world; a four dimensionalist may claim that to be Socrates is to be the aggregate of such-and-such temporal parts; and a trope theorist may claim that to be Socrates is to be the bundle of such-and-such tropes. I do not adopt these theories. However, my account of metaphysical grounding is able to accommodate these theories.

It is much harder to accommodate the view that properties are abstracted from states of affairs or facts. According to this view, no properties are constituted. So, to talk about property constitution makes no sense. However, one who adopts this view may still accept that to be a property P is to be the

thing abstracted from such-and-such states of affairs or facts. My feeling is that if

a neutral terminology can be found, this view can be accommodated in the end.

Chapter 2: Real Definition Statement and Property Constitution

The aim of this chapter is to argue for a necessary and sufficient condition for a real definition statement to be true. More specifically, I will argue for the constitution-real definition link (C-D):

(C-D) "To be X is to be Y" is a true real definition statement if and only if "to be Y" shows a deeper constitution of the property of being X than "to be X" does.

Here is the structure of the chapter. In section I, I will start with a few true real definition statements and argue that instances of the schema "to be X is to be Y" are focal real definition statements. In section II, I raise four problems as to the biconditional claim that "to be X is to be Y" is a true real statement if and only if the property of being X is identical with the property of being Y. In section III and section IV, a property theory is proposed to address the problem about the identity condition of properties. In section V, I argue that property identity is necessary, but not sufficient, for a real definition statement to be true. In section VI, I argue for the constitution-real definition link (C-D).

I. Real Definition Statement

There are *prima facie* true real definition statements. Candidate examples are ample. Here are just a few.

(a) To be a bachelor is to be an unmarried man.

(b) To be knowledge is to be justified true beliefs which satisfy X. (X is the needed fourth condition to avoid Gettier problems.)

(c) To be an even number is to be a natural number divisible by 2.

(d) To be water is to be the chemical compound composed of many molecules all of which are composed of two hydrogen atoms and one oxygen atom being bonded.

By conceptual analysis, we know that (a) is true; by philosophical analysis, we know that (b) is true; by mathematical inquiry, we know that (c) is true; and by chemical inquiry, we know that (d) is true. (For the distinction between philosophical analysis and conceptual analysis, see King (1998; 2016).) It is clear that real definition statements are known to be true by all inquiries, not just by linguistic competence. Therefore, Fine (1994a; 1995) and Rosen (2010; 2015) distinguish the notion of real definition from the notion of linguistic definition.

As is shown by the above examples, many true real definition statements are instances of the schema "to be X is to be Y." Here, I use "to be X is to be Y" instead of "to be F is to be G" because I want to accommodate instances such as "to be Socrates is to be …" (In this case, the first occurrence of "be" expresses the identity relation.)

However, not all true real definition statements are instances of "to be X is to be Y." Some true real definition statements are instances of the schema "to F is to G," for example, "to run is to …" Definitely, these two schemata are distinct, but I will take the latter schema as a special case of the former one. What I claim

later about instances of the schema "to be X is to be Y" apply equally to instances of the schema "to F is to G."

A genuine alternative to the current schema is the schema "for a to be X is for b to be Y." Its instances can also be true real definition statements. For example, if facts are just obtaining states of affairs (Horwich, 1998), then "for the fact of a's being F to exist is for the state of affairs of a's being F to obtain" is a true real definition statement. If Speaks' (2011) reduction of propositions to properties works, then "for the proposition that a is F to be true/false is for the property of being such that a is F to be instantiated/uninstantiated" is also a true real definition statement.

Instances of the schema "for something to be X is for it to be Y" and the schema "for that φ to be the case is for that ψ to be the case" can also be true real definition statements. For example, "for something to be an even number is for it to be a natural number divisible by 2" and "for that a is a bachelor to be the case is for that a is an unmarried man to be the case" are both true real definition statements. Let me take these two schemata as special cases of the schema "for a to be X is for b to be Y."

Now we have two major schemata "to be X is to be Y" and "for a to be X is for b to be Y." I believe that we should take instances of the former schema as focal real definition statements.

Let us consider the opposite view first. Correia and Skiles (2017) take instances of the schema "for a to be X is for b to be Y" as focal cases of

generalized identity. The same idea applies here: one might take instances of "for a to be X is for b to be Y" as focal real definition statements.

Such a view can be defended by appealing to the following two premises: (i) that some real definition statements hold (partly) in virtue of what a is and/or what b is, and (ii) that such real definition statements have to be formulated with the schema "for a to be X is for b to be Y." (The argument is formulated in terms of "identification" by Dorr (2016).)

I agree with (i). However, (ii) is false. These real definition statements can also be formulated with the schema "to be X is to be Y": it is easy to paraphrase "for a to be X is for b to be Y" into "to be such that a is X is to be such that b is Y." For example, the above two examples can be paraphrased into

(e) To be such that the fact of a's being F exists is to be such that the state of affairs of a's being F obtains.

(f) To be such that the proposition that a is F is true/false is to be such that the property of being such that a is F is instantiated/uninstantiated.

In contrast, there is a reason to take instances of the schema "to be X is to be Y" as focal real definition statements. Some real definition statements do not hold in virtue of what a is and what b is. The schema "to be X is to be Y" allows us to leave them out. In contrast, the schema "for a to be X is for b to be Y" does not have such an advantage. It is difficult to isolate those in virtue of which a real definition statement holds from the rest. The closest we may have is "for something to be X is for it to be Y" or "for anything, for it to X is for it to be Y."

However, generalizations are redundant here: they play no role for the real definition statements to hold.

Given the above two considerations, it is rational to mainly focus on instances of the schema "to be X is to be Y." (My argument is about focal expressions, not about eliminability of some expressions. By offering the above paraphrases, I do not thereby claim that the schema "for a to be X is for b to be Y" are eliminable. I will return to the schema later.)

On the other hand, not all true instances of the schema "to be X is to be Y" are true real definition statements. Here are a few examples:

(g) To be today is to be the day that this sentence is uttered.

(h) To be an attorney is to be an attorney.

(i) To be an attorney is to be a lawyer.

(j) To be knowledge is to be beliefs.

(k) To be is to be either a concrete existent or an abstract existent or a nonexistent (if there is any).

(l) To be an even number is to be either 0 or 2 or 4 ….

(m) To be water is to be the thing that is actually colorless, transparent, odorless, and tasteless liquid at room temperature, and forms the seas, lakes, rivers, and rain, and is the basis of the fluids of living organisms.

(Dorr (2016) also believes that not all true instances of the schema "to be X is to be Y" are true "identifications." But, as the term "identification" suggests, he allows for reflexive and symmetrical identifications, such as (h) and (i) which I do not take as true real definition statements.)

Intuitively, each statement may convey truth in some contexts. It is interesting to wonder whether it is the semantic contents they express or whether it is the pragmatic contents they communicate that are true (King & Stanley, 2005). Given the space limit, I cannot go into this debate. Since the intended truths they convey are systematically determined by the semantic contents of their components as well as the world, I venture to claim that the evidence weighs in favor of true semantic contents. If I am right, all of them express true semantic contents, and therefore are true statements, in appropriate contexts. However, they are plausibly not true real definition statements. I will return to these examples and explain why they are not later.

To sum up, I argue in this section that instances of the schema "to be X is to be Y" are focal real definition statements, and that some but not all true instances of the schema are true real definition statements.

II. Turn to the Level of Reference and the Problems

Only at the level of reference can we explain some phenomena of real definition statements. So, there are *prima facie* reasons to turn to the level of reference. It is quite natural to believe that "to be X is to be Y" is a true real definition statement if and only if the property of being X is identical with the property of being Y (under the assumption that "to be X" and "to be Y" refer to the property of being X and the property of being Y respectively). However, this view has four problems to be addressed.

Here are some phenomena of real definition statements to be explained at the level of reference. First, we observe that "to be Hesperus is to be Y" is a true real definition statement if and only if "to be Phosphorus is to be Y" is a true real definition statement. Also, "to be X is to be G(Hesperus)" is a true real definition statement if and only if "to be X is to be G(Phosphorus)" is a true real definition statement. These two biconditionals do not appear to hold primitively. Plausibly, they are somehow explained by the identity of Hesperus and Phosphorus at the level of reference. The exact detail of such an explanation is to be set aside. However, we have a good reason to consider the level of reference.

Second, it appears that if no statements of the form "to be F is to be H" are true real definition statements, and the infinitives "to be F" and "to be G" are co-referring, then no statements of the form "to be G is to be H" are true real definition statements. Let us suppose for the heuristic purpose that electrons are fundamental entities. Then no statements of the form "to be an electron is to be H" are true real definition statements. It is obvious that, in this case, no statements of the form "to be a β particle is to be H" can be true real definitions statements either. Here, "to be an electron" and "to be a β particle" are co-referring. So, it appears that whether statements of the form "to be F is to be …" can be true real definition statements hinges on the referent of the infinitive "to be F."

Third, it appears that if "to be X is to be Y" is a true real definition statement and "a is X" is true, then, for anything, it is a truth-maker of "a is X" if and only if it is a truth-maker of "a is Y." For example, "Leonardo da Vinci is a bachelor" and

"Leonardo da Vinci is an unmarried man" have the same truth-maker(s). Given that truth-makers belong to the level of reference, we have a good reason to turn to the level of reference.

Finally, true real definition statements close the gap of metaphysical explanations: if "to be X is to be Y" is a real definition statement, then the biconditional "a is X if and only if a is Y" demands no metaphysical explanation. (Rayo (2013) put it in terms of "just is"-statement.) Suppose that metaphysical explanations belong to the level of reference. That is, if metaphysical explanations hold, then they hold independent of how we describe or conceptualize the world. Then Rayo's observation also gives us a good reason to turn to the level of reference.

To explain all the above phenomena, we need to consider the question what is required at the level of reference for a real definition statement to hold. A simple answer is:

(SA) "To be X is to be Y" is a true real definition statement if and only if the property of being X is identical with the property of being Y.

(Here, the property of being X and the property of being Y are referred to by the infinitives "to be X" and "to be Y".)

The argument for SA can be put as follows. Consider a real definition statement "to be X is to be Y." Suppose that our best semantics tells us: in this statement, the infinitives "to be X" and "to be Y" refer to the property of being X and the property of being Y respectively and "is" expresses the identity relation.

Then the statement is true if and only if the property of being X is identical with the property of being Y.

However, there are four problems with SA and its argument. First, semantics alone cannot tell us that "to be X" and "to be Y" refer to properties in the case of real definitions. Whether it is true or false also depends on the nature of properties. So, we need an argument to show that properties, given their nature, are fit for the role of being referred to by the infinitives.

Second, assuming that the infinitives refer to properties, without a theory of property identity, it is still unclear what SA entails. Suppose for example that "to be X is to be Y and Z" is a true real definition statement. SA entails that, in this case, the property of being X is identical with the property of being Y and Z. Does it hereby entail that, in this case, the property of being X is distinct from the property of being Z and Y? SA leaves it open. It shows that, to evaluate SA, we must have in advance a theory of property identity.

Third, the above argument, in essence, assumes that the statements "to be X is to be Y" and "the property of being X is identical with the property of being Y" are semantically equivalent. However, it has been argued that they are not semantically equivalent (Correia & Skiles, 2017; Dorr, 2016). The former statement is ontologically innocent: its truth does not require the existence of properties. However, the latter statement is ontologically loaded: its truth requires property realism. Hence, there are no easy arguments from the statement "to be F is to be G" to the statement "the property of being F is identical with the

property of being G." One can be rational to believe the former without believing the latter.

Finally, identity is reflexive and symmetrical. Suppose that "to be X is to be Y" is a true real definition statement if and only if the property of being X is identical with the property of being Y. It is easy to derive that "to be X is to be X" is a true real definition statement, and that "to be X is to be Y" is a true real definiton statement if and only if "to be Y is to be X" is a true real definition statement. That goes against our intuition.

III. The Referents of Infinitives and Their Identity Condition

So far, I have raised four problems with SA and its argument. In this section, I will address the first two problems. As to the first problem, we need an argument to show that properties, given their nature, are fit for the role of being referred to by infinitives in real definition statements. (For convenience, I simply call those infinitives in real definition statements "infinitives.")

Here is the argument: infinitives refer to bipolar hyper-intensional predicable entities; given that properties are such entities, it follows that properties are fit for the role.

First, the referents of infinitives are hyper-intensional entities. Consider the following two real definition statements: "To be X is to be such that ψ" and "To be X is to be such that ψ and 1+1=2." We have the intuition that at most one of them can be true. Suppose for reduction that infinitives refer to intensional entities.

Then "to be such that ψ" and "to be such that ψ and 1+1=2" refer to the same intensional entity. That leads to absurdity: substitution of co-referential terms does not preserve truth.

Second, the referents of infinitives are bipolar entities. Typical examples of bipolar entities are properties, states of affairs, and propositions. They are bipolar because they can be instantiated or uninstantiated, obtained or unobtained, and true or false respectively. It is obvious that the referents of infinitives must be bipolar: the truth of the real definition statement "to be red is to be Y" does not require anything to be Y (Correia & Skiles, 2017); so, the real definition statement "to be red is to be Y" holds even if the referent of "to be Y" applies to nothing. The same can be said of the infinitive "to be red."

Finally, the referents of infinitives cannot be nullary. In other words, they must be predicable. Take the real definition statement "to be a bachelor is to be an unmarried man." Both infinitives must refer to entities predicable of other entities. That rules out states of affairs and propositions to be referents of infinitives (assuming that van Inwagen (2006) is right in that propositions are just nullary properties).

Given that properties are bipolar hyper-intensional predicable entities, it follows that properties are fit for the role of being referred to by infinitives. That does not entail that infinitives refer to properties. After all, there could be other entities which are equally fit for the role. But, at least, we have a good reason to take as a working hypothesis that infinitives refer to properties and see how fruitful it can be.

Now turn to the second problem. As we have observed, we need a theory of property identity to evaluate SA. I will argue (i) that commutation and conversion of non-symmetricals and commutation of symmetricals give rise to the same referent, and (ii) that distinct logical operations and Δ-conversion give rise to distinct referents.

First, commutation and conversion of non-symmetricals give rise to the same referent. In other words, "to be such that Rab" and "to be such that $R^{-1}ba$" have the same referent, where R^{-1} is the converse relation of R. For example, "to be such that a is less than b" and "to be such that b is greater than a" have the same referent.

The argumentative strategy is as follows. We are capable of making intuitive judgments about whether there is a fact of the matter as to the question "whether to be X is to be Y or to be Z." If there is no fact of the matter, then "to be Y" and "to be Z" are co-referring. Given that infinitives refer to properties, it follows that the property of being Y and the property of being Z are identical.

In this particular case, there is *prima facie* no fact of the matter as to the question "whether to such that X is acidic is to be such that X's pH is less than 7 or to be such that 7 is greater than X's pH." Without further counter-argument, I take "to be such that a is less than b" and "to be such that b is greater than a" to refer to the same property.

Second, commutation of symmetricals gives rise to the same referent. In other words, "to be such that Rab" and "to be such that Rba" have the same referent, where R is a symmetrical relation. It applies to symmetrical functions

and connectives as well. For example, "to be such that a equals b" and "to be such that b equals a" have the same referent; "to be Y and Z" and "to be Z and Y" have the same referent. It is because there are *prima facie* no facts of the matter as to the questions "whether to be X is to be such that a equals b or to be such that b equals a" and "whether to be X is to be Y and Z or to be Z and Y." Without further counter-argument, I take both pairs of infinitives to refer to the same property.

The same holds true of associative relations and functions of n arity or variable arity, and associative connectives of n formulas and variable formulas as well, where n is not less than 3. For example, there is *prima facie* no fact of the matter as to the question "whether to be water is to be …. two hydrogen atoms and one oxygen atom being bonded or to be … one oxygen atom and two hydrogen atoms being bonded." These cases can be seen as extensions of the commutation of symmetricals case.

So far, I have argued how coarse-grained referents of infinitives are: commutation and conversion of non-symmetricals and commutation of symmetricals give rise to the same referent. Let us now turn to the question how fine-grained referents of concepts are.

First, distinct logical operations give rise to distinct referents. Let us start with the double negation case. Plausibly, "to be such that ψ" and "to be such that $\neg\neg\psi$" have distinct referents. It is because there is a fact of the matter as to the question "whether to be X is to be such that such that ψ or to be such that $\neg\neg\psi$." For example, given a suitable "F", we have "to be such that a is water is to be

such that a is F, not to be such that ¬¬(a is F)." Moreover, the referent of "to be such that ψ" is plausibly more fundamental than the referent of its double negation; and hence distinct. (By the same token, "to be Y" and "to be Y and Y" have distinct referents; so do "to be Y" and "to be Y or Y", as well as other logical operations.)

That definitely does not entail the stronger claim that distinct logical operations give rise to distinct referents (except for commutation and conversion of non-symmetricals and commutation of symmetricals). Consider the distribution of negation case. There seems no fact of the matter as to the question "whether to be such that ¬(a is jade) is to be such that ¬(a is nephrite or a is jadeite) or to be such that ¬(a is nephrite) and ¬(a is jadeite)." So, it seems false that distinct logical operations give rise to distinct referents.

However, there is a reason to support the stronger claim. Suppose for reduction that distribution of negation gives rise to the same referent. Then the very same property has two distinct ways of constitution. For example, the property of not being jade is not a negative property *simpliciter*. Instead, we should say that it is negative relative to one way of constitution but it is conjunctive relative to the other way of constitution. This goes against the orthodox view.

Second, Δ-conversion gives rise to distinct referents. That is to say, "to be such that a is F" and "to be such that a instantiates the property of being F" have distinct referents. (Following Bealer (1982) and Jubien (2009), I use "Δ" to stand for the instantiation relation.) It is true that there seems no fact of the matter as to

the question "whether to be X is to be such that a is F or to be such that a instantiates the property of being F." Nevertheless, there are reasons to distinguish their referents.

Consider the statement "a instantiates the property of being F because a is F." Intuitively, this statement is true. Suppose that the statement is true only if the fact of a's being F is more fundamental than the fact of a's instantiating the property of being F. Then, plausibly, the referent of "to be such that a is F" is likewise more fundamental than the referent of "to be such that a instantiates the property of being F", and hence distinct.

(It also suggests a way out of Bradley's regress: Bradley correctly identifies an infinitive sequence of mutually distinct facts, nevertheless the direction of dependence is just the opposite of what Bradley takes it to be.)

Consider a different case. We have two infinitives "to be such that an ill-founded set S instantiates the property of being self-membered" and "to be such that S instantiates the property of being a member of S." Suppose for reduction that Δ-conversion gives rise to the same referent. Then these two infinitives must have the same referent, which is the same as the referent of "to be such that S is a member of S." However, Fine (1994b) has observed that S' instantiating the property of being self-membered is more fundamental than S' instantiating the property of being a member of S. If Fine is right, then, plausibly, the referent of the former infinitive is likewise more fundamental than the referent of the latter infinitive, and hence distinct. Therefore, Δ-conversion gives rise to distinct referents.

In sum, I show in this section that we have a good reason to take as a working hypothesis that infinitives refer to properties. Then I argue (i) that commutation and conversion of non-symmetricals and commutation of symmetricals give rise to the same referent, and (ii) that distinct logical operations and Δ-conversion give rise to distinct referents. It is true that, in a real definition statement "to be X is to be Y," I mainly focus on the infinitive "to be Y." However, by similar arguments, it is easy to show that the referent of the infinitive "to be X" is a property of the same graininess.

IV. A Property Theory

In this section, I will put forward a theory of hyper-intensional entities to accommodate the aforementioned identity condition of properties. It should be noted in advance that the theory is not intended to be original.

I believe that Bealer (1994) makes a good argument for type-free theory. Hence, there is only one identity relation, and there is only one existential quantifier.

I, in general, follow Bealer's *Quality and Concept* (1982): terms referring to properties can be abstracted from open or closed formulas, and they can be applied to other terms and return formulas; some properties are constituted by other properties, which corresponds to how formulas are composed.

The following are ways of property constitution and their examples (under the assumption that logical constants express ways of constitution).

Ways of Property Constitution		Examples	In Ordinary Discourse
Logical Constructions	Negation	[λx¬Fx] is constituted by [λxFx].	The property of not being F is constituted by the property of being F.
	Conjunction	[λxλy(Fx and Gy)] is constituted by [λxλyFx] and [λxλyGy].	The property of being x, y such that x is F and y is G is constituted by the property of being x, y such that x is F and the property of being x, y such that y is G.
	Disjunction	[λxλy(Fx or Gy)] is constituted by [λxλyFx] and [λxλyGy].	The property of being x, y such that x is F or y is G is constituted by the property of being x, y such that x is F and the property of being x, y such that y is G.
	Conditional	[λxλy(if Fx then Gy)] is constituted by [λxλyFx] and [λxλyGy].	The property of being x, y such that if x is F then y is G is constituted by the property of being x, y such that x is F and the property of being x, y such that y is G.
	Biconditional	[λxλy(Fx if and only if Gy)] is constituted by [λxλyFx] and [λxλyGy].	The property of being x, y such that x is F if and only if y is G is constituted by the property of being x, y such that x is F and the property of being x, y such that y is G.
	Universal Generalization	[λ∀xFx] is constituted by [λxFx].	The property of everything's being F is constituted by the property of being F.
	Existential Generalization	[λ∃xFx] is constituted by [λxFx].	The property of something's being F is constituted by the property of being F.
Expansion		[λxFa] is constituted by [λFa].	The property of being (x) such that a is F is constituted by the property of a's being F.
Predication		[λFa] is constituted by a and [λxFx].	The property of a's being F is constituted by a and the property of being F.

Here, the notion of constitution is understood as how properties are

constituted, not as how their linguistic representations are composed. Actually,

linguistic representations of a property may or may not show how the property is constituted. For example, even if "to be F" does not show it, the referent of "to be F" can be the double negation of the referent of "to be G." It can be shown by a different co-referring infinitive "to be ¬¬G."

The logical constructions of properties correspond to the logical operations on open or closed formulas: nullary properties correspond to closed formulas; other properties correspond to open formulas. For example, corresponding to "is F and G"'s being composed of "is F" and "is G", the property [λx(Fx and Gx)] is constituted by the properties [λxFx] and [λxGx]. (Here, the terms "[λx(Fx and Gx)]", "[λxFx]", and "[λxGx]" are abstracted from "is F and G", "is F", and "is G" respectively.) Corresponding to "something is F"'s being composed of "is F", we have it that [λ∃xFx] is constituted by [λxFx]. (Here, the term "[λ∃xFx]" is abstracted from the formula "something is F." [λ∃xFx] is a nullary property, which is distinct from [λx∃xFx], the unary property of being such that something is F.) Other logical constructions correspond to logical operations in similar ways.

Property constitution by expansion and by predication also correspond to composition of formulas. For example, corresponding to "is such that a is F"'s being composed of "a is F", we have it that the property [λxFa] is constituted by expanding the property [λFa]. (Here, terms "[λxFa]" and "[λFa]" are abstracted from "is such that a is F" and "a is F" respectively.) Corresponding to "a is F"'s being composed of "a" and "is F", we have it that [λFa] is constituted by predicating [λxFx] of a.

(It should be noted that expansion and predication are distinct from function abstraction and application: expansion and predication are ways of constitution of properties by properties; function abstraction and application are relations between formulas and terms.)

A few comments on the theory of property constitution are in order. First, it is easy to see that the above cases of correspondence are the base cases, and all other correspondences between properties and formulas can be defined recursively from the base cases.

Second, I officially stay neutral on some controversial cases of property constitution. Consider definite descriptions first. If Russellian theory of definite descriptions is right, then [λ(the F is G)] is constituted by way of existential generalization. If Fregean theory of definite descriptions is right, then it is constituted by predicating [λxGx] of [λxDx][λxFx], which is in turn constituted by predicating [λxDx] of [λxFx].

Turn to predicate modification. If predicate modification boils down to conjunction, then [λx(x is an unmarried man)] is readily constituted by [λx(x is unmarried)] and [λx(x is a man)]. If predicate modification is not conjunction (Balcerak Jackson, 2007), then we may need a different way of constitution that licenses the above constitution.

Finally, I have assumed so far that logical constants express ways of constitution. However, it might be argued that logical constants express constituents of properties, not ways of constitution. For example, "and" expresses [λxλyConj(x,y)], which is applied to [λFa] and [λGb] and returns [λ(Fa and Gb)]. If

so, we may reduce ways of constitution to expansion and predication, and take logical constructions as special cases of predication. For the current purpose, I do not need to take a stance on which approach is right: our choice does not affect the identity condition of properties as I argued in the previous section.

With the theory of property constitution, we are in a position to make clear the identity condition of properties. Properties are identical if and only if they are constituted in the same way by identical constituents. For now, let us assume that there are simple properties and fundamental objects by which all other properties are constituted. Then I propose the following constitutional isomorphism: (i) the identities of simple properties are brute, (ii) the identities of fundamental objects are brute, and (iii) constituted properties are identical if and only if they are constituted in the same way by identical constituents.

Here, I assume that constituents of a constituted property are more fundamental than the property. Admittedly, Bealer's theory does not entail that. However, we have an independent reason to take constituents as more fundamental.

It appears that how a constituted property is constituted is an essence of the property. Since constituents of the property figure in the essence, given Fine's (1995) account of ontological dependence, the property depends on its constituents. It follows that constituents of the property are more fundamental than the property.

A few comments are in order. First, constitutional isomorphism is an ontological criterion of identity, which is distinct from synonymous isomorphism, a semantic criterion of identity (Anderson, 2001).

Second, the condition (i) and (ii) entail that the identities of simple properties and fundamental objects are not reducible to modal notions. (As to the biconditional claimed by Bealer (1982) and Rosen (2015) that simple properties are identical if and only if they are necessarily co-extensive, that might be true. However, I do not have any good arguments for that; hence, I officially stay neutral on that.)

Third, the condition (iii) is required to accommodate distinct logical operations and Δ-conversion giving rise to distinct referents (except for the commutation and conversion of non-symmetricals case and the commutation of symmetricals case).

Finally, suppose that Dasgupta (2009) is right in that there is no primitive individuality, we can leave out the condition (ii). So, the aforementioned constitutional isomorphism is compatible with no primitive individuality.

In addition to constitutional isomorphism, I take it that Church's Alternative (0) holds true at the level of reference. That is, λ-conversion gives rise to distinct referents. The purpose is to ensure that distinct logical operations give rise to distinct referents. For example, "[λx(Fx and Gx)]a" and "Fa and Ga" are mutually derivable by λ-conversion. However, the former formula corresponds to a property constituted by predicating a conjuntive unary property of a, while the latter formula corresponds to a property constitued by conjoining two nullary

properties. To distinguish these two properties, I take λ-conversion to give rise to distinct referents.

(In many cases, I use "to be such that …" to indicate λ-abstraction. For example, "[λx(Fx and Gx)]a" can be rendered as "a is such that it is F and G." However, it can also be rendered without "to be such that …", like "a is F and G.")

Even though I do not adopt Church's Alternative (1), I adopt Anderson's (2001) modification (1*) of Alternative (1) to accommodate commutation and conversion of non-symmetricals and commutation of symmetricals giving rise to the same referent.

So far so good for the property theory. The theory is adequate to accommodate the identity condition of properties as I have previously argued. Of course, that does not amount to a full defense of the theory. However, given that my aim is not to defend the property theory but to apply the theory, I will operate under the assumption that this property theory is true.

V. Real Definition Statement and Property Identity

The aim of this section is to argue that property identity is necessary for a real definition statement to be true. More specifically, I will argue that (SA→), which is weaker than SA, is true:

(SA→) If "to be X is to be Y" is a true real definition statement, then the

property of being X is identical with the property of being Y.

In this argument, I will avoid the third problem with SA.

(SA→) has an initial plausibility. Consider an explicit definition statement "to be X is to be P and Q." Plausibly, in this case, the property of being X is identical with the property of being P and Q. Suppose further that "a is X" is true. Then we also have the intuition that the fact of a's being X is identical with the fact of a's being P and Q. After all, it is very implausible that facts about a can be multiplied by the explicit definition. Given that all explicit definition statements are true real definition statements, (SA→) holds true of some real definition statements.

An argument can be made for (SA→). Suppose the antecedent that "to be X is to be Y" is a true real definition statement. Consider a case in which "a is X" is true. As we have previously observed, intuitively in this case, "a is X" and "a is Y" have the same truth-maker(s). For the heuristic purpose, let us assume that each true sentence has one and only one truth-maker. Suppose further (i) that their truth-makers are the fact of a's being X and the fact of a's being Y respectively; (ii) that these two facts are constituted by a together with the property of being X and with the property of being Y respectively; and (iii) that facts are identical if and only if they are constituted in the same way by identical constituents. Then we are able to derive that the property of being X is identical with the property of being Y.

Now to assume otherwise: true sentences have more than one truth-makers. Suppose for reduction that the property of being X is not identical with the property of being Y. Given (ii) and (iii), it follows that the fact of a's being X is not identical with the fact of a's being Y.

Since "to be X is to be Y" is a true real definition statement, we have a further intuition (iv) that the fact of a's being X and the fact of a's being Y are explanatorily relevant in the sense that either they are identical, or one fact explains the other. Given that they are not identical, we have it that one fact explains the other. In this case, plausibly, the fact of a's being Y explains the fact of a's being X, and not the other way around.

Since the fact of a's being X does not explain the fact of a's being Y, given the plausible premises (v) that the fact of a's being Y is a truth-maker of "a is Y", and (vi) that all other truth-makers of "a is Y" explain the fact of a's being Y, it follows that the fact of a's being X is not a truth-maker of "a is Y",

Since the fact of a's being X is not a truth-maker of "a is Y", given that the fact of a's being X is a truth-maker of "a is X", it follows that "a is X" and "a is Y" do not have the same truth-makers. That is contrary to our intuition. So, the supposition for reduction is false: the property of being X is identical with the property of being Y (under the assumption that "a is X" is true).

Next, consider the opposite case in which "a is X" is not true. Then, "it is not the case that a is X" is true. In this case, we have the intuition that "it is not the case that a is X" and "it is not the case that a is Y" have the same truth-maker(s). By the same reasoning, we can also derive that the property of being X is identical with the property of being Y.

So, no matter whether "a is X" is true or not, we have it that if "to be X is to be Y" is a true real definition statement, then the property of being X is identical with the property of being Y. (SA→) is therefore true.

(One possible concern about this argument is equivocation. Constituent properties of facts might not be the properties referred to by infinitives in real definition statements. If so, then these two kinds of properties might not have the same identity condition. Even admitting that the constituent properties of facts, as I just argued, are identical, that does not entail that the properties referred to by the infinitives in true real definition statements are identical.

However, the equivocation thesis is not plausible. Consider a true statement "a is F." Suppose (i) that the fact that makes true "a is F" is constituted by the property expressed by "is F", (ii) that the property expressed by "is F" is the property referred to by its infinitive form "to be F", and (iii) occurrence in real definition statements does not change the infinitive "to be F"'s referent. It follows that the constituent property of the fact of a's being F is the property referred to by "to be F" in real definition statements. So, constituent properties of facts must have the same identity condition as the properties referred to by infinitives in real definition statements.)

Given that the property of being X is identical with the property of being Y, by constitutional isomorphism, the property of being X must have the same constitution as the property of being Y. It is not viable to claim that the property of being X is simple, while the property of being Y is constituted.

(It should be noted that Rosen's (2015) view is not that the property of being X is simple, while the property of being Y is constituted. He believes that these are identical properties and both of them are simple. He posits a distinct

proposition-like complex to stand in the real definition relation to the simple property. I will return to Rosen's point later.)

A few comments on this argument are in order. First, the argument does not rely on the questionable semantic equivalence thesis: I do not presuppose that "to be X is to be Y" and "the property of being X is identical with the property of being Y" are semantically equivalent. Instead, it appeals to our intuition about the sameness of truth-maker(s). Thereby, I avoid the third problem with SA.

Second, the argument applies equally to true real definition statements such as "to be a is to be the F." There is a reason to believe that, in these cases, the property of being a is identical with the property of being the F. For example, the property of being the singleton {Socrates} is identical with the property of being the set having Socrates as its sole member, and the property of being such that {Socrates} is G is also identical with the property of being such that the set having Socrates as its sole member is G. After all, there are *prima facie* no facts of the matter as to the questions "whether to be X is to be {Socrates} or to be the set having Socrates as its sole member" and "whether to be X is to be such that {Socrates} is G or to be such that the set having Socrates as its sole member is G."

More generally, I call "the F" a "definitional" description of an object a if and only if "the F" is a description of a and "to be a is to be the F" is a true real definition statement. There is a reason to believe that the substitution of "definitional" descriptions for names gives rise to the same referent.

(However, that does not apply to ordinary descriptions. Suppose for reduction that the property of being the evening star is identical with the property of being Hesperus and the property of being the morning star is identical with the property of being Phosphorus. Given that the property of being Hesperus and the property of being Phosphorus are identical, it follows that the property of being the evening star and the property of being the morning star are identical. That goes against our intuition about property identity.)

Third, the argument for (SA→) is not circular. Recall that I argue for the theory of property identity by considering whether there is a fact of the matter as to the question "whether to be X is to be Y or to be Z." This argument is only concerned with whether the property of being Y is identical with the property of being Z. Whether the property of being X is identical with the property of being Y is left open. So, (SA→) is not presupposed in the argument for the theory of property identity. Then, under the theory of property identity, I argue that (SA→) is true by appealing to the sameness of truth-maker(s). No circularity is involved.

Finally, the argument for (SA→) can be seen as an instance of an argument schema. Let us take any properties F and G. We have it that for any properties P and Q, if they are constituted in the same way by F and by G respectively (together with other identical constituents), then P and Q are identical if and only if F and G are identical. And for any facts, if they are constituted in the same way by P and by Q respectively (together with other identical constituents of facts), then these facts are identical if and only if P and Q are identical. Hence, by

appealing to the identities of some other properties or the identities of some facts, one can derive the identity of F and G.

Furthermore, there is a good reason to believe that facts are identical if and only if they play the same role in metaphysical explanation. Here is the argument. Given Leibniz's law, it is easy to derive that if facts are identical, then they play the same role in metaphysical explanation. Then consider its converse. Let us take any facts f_1 and f_2 and suppose that they are distinct. We need to show that they play different roles in metaphysical explanation.

Let me first suppose that f_1 explains f_2. Given the irreflexivity of explanation, we have it that they play different roles in metaphysical explanation: f_1 explains f_2, while f_2 does not explain f_2. The case is similar if f_2 explains f_1. Suppose otherwise that neither of them explains the other. Then we also have it that f_1 and f_2 play different roles in metaphysical explanation: f_1 is such that if f_1 explains f_3, then it explains f_3, while f_2 is not. Otherwise, it is very plausible that one of them explains the other. Hence, in either case, we have it that f_1 and f_2 play different roles in metaphysical explanation.

Given the above, by appealing to the sameness of roles played by facts in metaphysical explanation, one can derive the identity of facts and then the identity of properties. Plausibly, the above argument that appeals to the sameness of truth-maker(s) is an instance of arguments that appeal to the sameness of roles played by facts in metaphysical explanation.

(Actually, the close connection between property identity and metaphysical grounding has been noticed by Rosen (2015).)

One possible concern about (SA→) arises from ontological vagueness. For the current purpose, let us assume that there is ontological vagueness which cannot be explained away by appealing to semantic contextualism and epistemic ignorance. (For the debate on ontological vagueness, see Evans, 1978; Merricks, 2001). Suppose that the property of being a chair is such a vague property. Can we find a true real definition statement "to be a chair is to be Y"? My answer is yes. After all, in my account, nothing prevents "to be Y" from referring to an equally vague property.

Perhaps, the genuine question arises from further assumptions that there is supposed to be a true real definition statement "to be a chair is to be Y" such that "Y" is only composed of fundamental physical terms and that fundamental physics is not vague. I do not know whether fundamental physics is vague or not. But, for the current purpose, let us accept this assumption. However, in this case, "to be a chair is to be Y" is not a true real definition statement. The property of being Y, which is constituted by fundamental physical properties, is just a particular realizer of chairhood, not identical with chairhood. So, ontological vagueness does not pose a threat to (SA→).

Now turn to the converse of (SA→): if the property of being X is identical with the property of being Y, then "to be X is to be Y" is a true real definition statement. The converse is obviously false. A counter-example is that "to be a bachelor is to be a bachelor" is not a true real definition statement.

It follows that SA is false. Obviously, we need some further necessary conditions for real definition statements to be true.

VI. *Real Definition Statement and Property Constitution*

We have seen in the previous section that SA fails. In this section, I will improve on SA. I will argue that "to be X is to be Y" is a true real definition statement if and only if "to be Y" shows a deeper constitution of the property of being X than "to be X" does. I will show that this necessary and sufficient condition resolves the fourth problem with SA.

Let me introduce a few terminologies first. According to the aforementioned property theory, there is one and only one way in which a constituted property P is constituted by simple properties and fundamental objects. However, there can be more than one ways in which P is constituted by its constituents. Here, the constituents of P can be the simple properties or the fundamental objects that constitute P, or can be properties constituted by any of them in the way in which they constitute P. For example, the property of being a man is a constituent of the property of a bachelor, even though the property of being a man is plausibly not a simple property. Henceforth, I understand "a way of constitution" in the second sense, and I will use "a constitution" to stand for a way of constitution for convenience.

Let us stipulate that a linguistic representation of a property shows a constitution of the property if and only if (i) all the components of the linguistic representation represent some constituents of the property, and (ii) the way in

which the represented constituents constitute the property corresponds to the way in which the components compose the linguistic representation.

Here, the notion of correspondence is not mysterious: as I have previously argued, it can be defined recursively from the base cases.

Consider a simple case in which "to be X" does not show any constitutions of the property of being X. In this case, "to be X is to be Y" is a true real definition statement if and only if (i) the property of being X is identical with the property of being Y, and (ii) "to be Y" shows a constitution of the property of being X.

For example, "to be a bachelor" does not show any constitutions of the property of being a bachelor. In this case, "to be a bachelor is to be an unmarried man" is a true real definition statement if and only if the properties to which they refer are identical and "to be an unmarried man" shows a constitution of the property.

Here is the argument. First, suppose that "to be X is to be Y" is a true real definition statement. As I have previously argued, it follows that the properties to which these infinitives refer are identical. We have (i). Also, we want to rule out that "to be an attorney is to be a lawyer" is a true real definition statement. For that purpose, we must require "to be Y" to show a constitution of the property of being X (given that "to be X" does not show any constitutions of the property of being X). Hence, we have it that (ii).

Then, consider its converse. Suppose that (i) and (ii). That is, "to be X" and "to be Y" are co-referring, "to be Y" shows a constitution of the property of being X, while "to be X" does not. Clearly, I rule out cases such as "to be an attorney is

to be a lawyer." Suppose that such cases are the only cases in which "to be X is to be Y" is not a true real definition statement (given that "to be X" and "to be Y" are co-referring). It follows that in all remaining cases, "to be X is to be Y" is a true real definition statement.

Given constitutional isomorphism, it is easy to see that (i) is entailed by (ii). Hence, (i) is redundant. So, we have it that "to be X is to be Y" is a true real definition statement if and only if "to be Y" shows a constitution of the property of being X (under the assumption that "to be X" does not show any constitutions of the property of being X). The argument equally applies to true real definition statements such as "to be a is to be the F". In this case, "to be the F" shows a constitution of the property of being a.

The idea can be naturally extended to the cases in which "to be X" shows a constitution of the property of being X. In this case, "to be X is to be Y" is a true real definition statement if and only if (i) "to be Y" shows a constitution of the property of being X, (ii) for any constituent of the property of being X, if some component of "to be X" represents it, then some component of "to be Y" represents it, and (iii) there is a constituent of the property of being X such that no components of "to be X" represent it, but some component of "to be Y" represents it. For example, "to be a bachelor and a lonely man is to be an unmarried man and a lonely man" is a true real definition statement.

Let us stipulate that "to be Y" shows a deeper constitution of the property of being X than "to be X" does if and only if (i), (ii) and (iii). Then we have the constitution-real definition link:

(C-D) "To be X is to be Y" is a true real definition statement if and only if "to

be Y" shows a deeper constitution of the property of being X than "to be

X" does.

(C-D) equally applies to true real definition statements such as "to be such

that a is G is to be such that the F is G". In this case, "to be such that the F is G"

shows a deeper constitution of the property of being such that a is G than "to be

such that a is G" does.

(C-D) resolves the fourth problem with SA. For example, "to be an unmarried

man is to be a bachelor" is not a true real definition statement because "to be a

bachelor" does not show any constitutions of the property of being a bachelor.

More generally, it is not the case that if "to be X is to be Y" is a true real

definition statement, "to be U" and "to be X" are co-referring, and "to be V" and

"to be Y" are co-referring, then "to be U is to be V" is a true real definition

statement.

It should be clear that if I let in "to be a bachelor is to be a bachelor" as a true

real definition statement (as Correia & Skiles (2017) do to generalized identity,

Dorr (2016) does to "identification" and Rayo (2013) does to "just is"-statement),

then there is no need to go into the discussion about property constitution. As we

will see later, without appealing to the theory of property constitution, my account

of metaphysical grounding would be impossible.

Now we are in a position to return to the examples from (g) to (m) in section I

and see why they are not real definition statements. (g) fails because, without

being relative to a certain context, "to be today" does not refer to any properties.

(h) and (i) fail because no constitutions of the property of being an attorney are shown. Statements from (j) to (m) are not real definition statements because, in each statement, the first infinitive and the second infinitive do not refer to the same property. For example, the property of being water is distinct from the property of being the thing that is actually colorless, …, and is the basis of the fluids of living organisms, even though water does have the latter property.

Two comments on (C-D) are in order. First, every example I have considered so far is a real definition statement about one entity. But there can be a true real definition statement about a pair of entities which is not reducible to any true real definition statements about any of those entities. Following Fine (1994b), we can call such statements "reciprocal real definition statements." There is no reason that (C-D) cannot accommodate them.

Second, (C-D) presupposes that infinitives in true real definition statements have referents. However, the infinitives in a true statement "to be X is to be Y" may not have referents. The true statement "to be not-self-instantiated is to fail to instantiate itself" is a case in point (Correia & Skiles, 2017; Dorr, 2016). I have a good reason not to consider cases like that: such statements are not true real definition statements; after all, nothing *real* is defined by them.

At the end, I want to make a brief comparison between my view with Fine's and Rosen's accounts of real definition and anticipate future work. In this chapter, I only discuss real definition statements and bracket the question whether there is the real definition relation. Nothing claimed so far commits me to a *real* real definition relation. It could be the case that what we *really* have is

property identity and property constitution. As we will see in the next chapter, my account of metaphysical grounding does not presuppose that there is such a relation.

In contrast, both Fine (1994a; 1995) and Rosen (2010; 2015) argue that the real definition relation exists. Rosen takes real definition to be a relation between a simple property and a distinct proposition-like complex. Take "to be a bachelor is to be an unmarried man" for example. Rosen takes real definition to be a relation between the property of being a bachelor, which is identical with the property of being an unmarried man, and a distinct proposition-like complex <x is an unmarried man>.

On my view, positing both entities appears perplexing. If the proposition-like complex <x is an unmarried man> and the property of being an unmarried man are distinct, then they plausibly constitute two distinct Russellian propositions together with the same object a. Then what is the relation between these two Russellian propositions? How to make sense of the claim that the proposition <a is an unmarried man>, which is constituted by <x is an unmarried man> and a, is not constituted by the property of being an unmarried man? Can we conjoin a simple property with a proposition-like complex? Can this conjunctive entity stand in real definition relation? These are perplexing questions to be addressed.

Fine (1994a; 1995) takes real definition to be a relation between the object defined and propositions true in virtue of the identity of the object. In other words, real definition is a relation between an object and its essences.

Since I take metaphysical grounding as *real*, I have no good reasons to reject the notion of essence and Fine's real definition relation. As I believe, all these notions can be defined in terms of property constitution and property instantiation. In contrast, Fine (2012) takes essence as fundamental and defines real definition and metaphysical grounding in terms of essence; Rosen (2015) takes metaphysical grounding as fundamental and defines real definition in terms of metaphysical grounding. What are the advantages and disadvantages of each approach? Which approach is preferable? These are serious questions which deserve to be addressed in a separate essay.

Chapter 3: Metaphysical Grounding and Property Theory

The aim of this chapter is to offer an account of metaphysical grounding based on the property theory previously proposed. More specifically, I will argue that metaphysical grounding can be defined with the notion of determinant assignment and its factualization, which can in turn be defined in terms of property constitution and property instantiation. Hence, metaphysical grounding can be defined in terms of property constitution and property instantiation.

Here is the structure of the chapter. In section I, I will introduce the notion of metaphysical grounding and relate true grounding claims to true factive real definition statements. It suggests that defining metaphysical grounding in terms of property constitution and property instantiation might be promising. I will carry out the project in the remaining sections. From section II to section IV, I define the notion of determinant assignment and its factualization in terms of property constitution and property instantiation. In section V and VI, I offer an account of metaphysical grounding with the notion of determinant assignment and its factualization.

I. *"Because" and Factive Real Definition Statement*

There has been a growing interest in the notion of metaphysical grounding. Here are a few examples.

(a) The singleton {Socrates} exists because the set having Socrates as its sole member exists.

(b) The water molecule W has a positive pole because the molecule composed of two hydrogen atoms H_1 and H_2 and one oxygen atom O being bonded has a positive pole.

(c) The thing A breaks off during the wind storm because the upper part of the flagpole breaks off during the wind storm.

(d) The hole is circular because the opening through the wall is circular.

(e) The boundary is marked by the Potomac River because the line dividing Washington D. C. and Virginia is marked by the Potomac River.

(f) The geometric center lies outside the figure because the mean position of all the points in the figure lies outside the figure.

(g) Sherlock Holmes lives in 221b Baker Street according to *A Study in Scarlet* because the fictional detective created by Sir Arthur Conan Doyle lives in 221b Baker Street according to *A Study in Scarlet*.

(h) The square is a rectangle because the plane figure enclosed by L_1, L_2, L_3, and L_4 with four equal straight sides and four right angles is a plane figure with four straight sides and four right angles.

(i) A has mass because A has some determinate mass or other.

(j) A is a ship because A is a large vehicle for transporting people and goods on water.

(k) Leonardo da Vinci is a bachelor and an artist because Leonardo da Vinci is a bachelor and Leonardo da Vinci is an artist.

(l) Leonardo da Vinci is a bachelor because Leonardo da Vinci is unmarried and Leonardo da Vinci is a man.

(m)Tully is identical with Cicero because the human being with the origin O is identical with the human being with the origin O.

(n) The property of being a bachelor is identical with the property of being an unmarried man because the property constituted in the way W by constituents C is identical with the property constituted in the way W by constituents C.

The above (a) is about set membership; (b) and (c) are about the part-whole relation; (d), (e), (f) and (g) are about dependent entities holes, boundaries, geometric centers, and fictional characters respectively; (h), (i), and (j) are about species and genus, determinables and determinates, and functional properties respectively; (k) and (l) pertain to property constitution; and finally (m) and (n) are about object identity and property identity.

Obviously, I circumvent some difficult problems, such as metaphysical grounding about the logical, the numerical, the mental, the semantic, the normative, and the aesthetic. But I have good reasons to do so. For one thing, to introduce the notion of metaphysical grounding, it would be better to start with straightforward examples. For another, the aim of this chapter is to account for the notion of metaphysical grounding. Resolving these difficult problems lies outside the scope of the chapter.

As is shown by the above examples, metaphysical grounding can be expressed by instances of the schema "a is X because b is Y." Consider a

grounding claim "a is X because b is Y" and the corresponding real definition statement "for a to be X is for b to be Y". There is an important difference between them. That is, the real definition statement, if true, does not require "a is X" nor "b is Y" to be true. In contrast, if the grounding claim "a is X because b is Y" is true, then both "a is X" and "b is Y" are true.

For example, even though Socrates is not a bachelor, the real definition statement "for Socrates to be a bachelor is for him to be an unmarried man" is still true. However, the corresponding grounding claim "Socrates is a bachelor because he is an unmarried man" appears to be false.

Despite the difference, real definition statements and grounding claims are closely connected. From the examples (a)-(n), it is easy to see that if the real definition statement "for a to be X is for b to be Y" is true, and both "a is X" and "b is Y" are true, then the corresponding grounding claim "a is X because b is Y" is true. (Actually, it suffices to require either "a is X" or "b is Y" to be true.)

For example, if the real definition statement "for W to have a positive pole is for the molecule composed of H_1, H_2, and O being bonded to have a positive pole" is true, and "W has a positive pole" is true, then (b) is a true grounding claim. If the real definition statement "for A to have mass is for A to have some determinate mass or other" is true, and "A has mass" is true, then (i) is a true grounding claim.

Hence, to account for the notion of metaphysical grounding, we can start with real definition statements "for a to be X is for b to be Y", where both "a is X" and

"b is Y" are true. Let us call such real definition statements "factive real definition statement." Then we have the real definition-grounding link (D-G):

(D-G) If "for a to be X is for b to be Y" is a true factive real definition statement, then "a is X because b is Y" is a true grounding claim.

As I argued in Chapter 2, infinitives in real definition statements refer to properties. Now what are the referents of "for a to be X" and "for b to be Y" in the factive real definition statement "for a to be X is for b to be Y"?

There are two answers. On the one hand, "for a to be X" is an infinitive with subject. Plausibly, like other infinitives, it refers to a property. Given that "to be X" refers to the property of being X, plausibly, "for a to be X" refers to the nullary property of a's being X, which obtains given factivity. (Here, obtaining is just a limiting case of instantiation.) On the other hand, some might take "for a to be X" to refer to a fact which is constituted by a and the property of being X.

Now whether "for a to be X" refers to the obtaining nullary property of a's being X or the fact of a's being X? On my view, these two answers are the same. It is because facts are just obtaining nullary properties.

The argument is as follows. Suppose for reduction that facts are not obtaining nullary properties. Then the fact of a's being such that it stands in R to b is distinct from the obtaining property of a's being such that it stands in R to b. We know that the above fact is constituted by a and the property of standing in R to b, so is the obtaining property. In other words, they have the same constituents. It follows that fact constitution is a distinct relation from property constitution.

Being committed to two distinct constitution relations comes with costs. One may wonder, for example, why the fact of Socrates' being wise must exist if the property of Socrates' being wise obtains. Is it a brute fact which cannot be further explained?

In addition, this view faces a dilemma: either it is ad hoc, or it will multiple facts and properties. Consider the first horn. It is ad hoc to say that two constitution relations only operate when a fact is constituted. If there are two distinct constitution relations applied to the above a and the property of standing in R to b if Rab holds, then there should be two distinct constitution relations applied to them if Rab does not hold. Also, there should be two distinct constitution relations applied to b and the relation R. Otherwise, it looks like, in all other cases, there is only the property constitution relation at work. When a fact is constituted, suddenly a new constitution relation pops up.

Consider the second horn. If there are indeed two distinct constitution relations operating at any level of constitution, then there will be too many facts and too many properties. For example, the above property is constituted by a and the property of standing in R to b, which is in turn constituted by b and the relation R. In either level of constitution, one can understand it in terms of property constitution or in terms of fact constitution. We end up with four entities. That goes against our intuition.

Given the above argument, the infinitives "for a to be X" and "for b to be Y" refer to nullary properties. If so, then the constitution-real definition link (C-D) can be readily applied here. We know that "a is X" is true if and only if the property of

a's being X obtains. By (C-D), we have it that "for a to be X is for b to be Y" is a true factive real definition statement if and only if "for b to be Y" shows a deeper constitution of the obtaining property of a's being X than "for a to be X" does. Given (D-G), we can derive the conditional that if "for b to be Y" shows a deeper constitution of the obtaining property of a's being X than "for a to be X" does, then "a is X because b is Y" is a true grounding claim.

We know that true real definition statements show property constitution, and factivity is a matter of property instantiation. Hence, (D-G) suggests that defining metaphysical grounding in terms of property constitution and property instantiation might be promising. I will carry out this project in the remaining sections.

There are three concerns about (D-G). First, it is true that if "for a to be X is for b to be Y" is a true factive real definition statement, then "a is X because b is Y" a true grounding claim. However, the grounding relation cannot be one between the fact of a's being X and the fact of b's being Y. It is because, given the property theory proposed in Chapter 2, the fact of a's being X is identical with the fact of b's being Y, but the grounding relation is supposed to be irreflexive. Then what does the grounding relation relate? From section II to section IV, I define the notion of determinant assignment, which allows me to "break" the fact of a's being X into "simpler" fact(s). In section V, I propose to let these "simpler" fact(s) ground the fact of a's being X.

Second, the truth of factive real definition statements is merely a sufficient condition for grounding claims to be true. Take "A has mass because A has 8-

kilogram-mass" for example. Intuitively, it is a true grounding claim (under the assumption that A has 8-kilogram-mass). However, the corresponding factive real definition statement "for A to have mass is for A to have 8-kilogram-mass" is false. How to cover such cases? I will address this concern in section VI.

Finally, (D-G) only specifies a condition under which a grounding claim is true. But what is metaphysical grounding itself? Metaphysical grounding is supposed to be a pure metaphysical notion. (D-G) itself does not tell us what metaphysical grounding is. In section VI, I will offer an account of metaphysical grounding in terms of property constitution and property instantiation, and thereby remove the concern.

To sum up this section, I introduce the notion of metaphysical grounding with a few examples. Then, I argue for the real definition-grounding link (D-G) between factive real definition statements and grounding claims. Finally, I raise three concerns to be addressed later.

II. *Logically Constructed Nullary Property and Determinant Assignment*

In the next three sections, I will introduce the notion of determinant assignment and account for the notion guided by our intuition about it. In sections V and VI, I will use this notion to define metaphysical grounding. These sections are formal and complicated. Before going into details, let me first explain the motivations behind it.

First, as has been mentioned, we cannot let the fact of b's being Y ground the fact of a's being X, if "for a to be X is for b to be Y" is a true factive real definition statement. With the notion of determinant assignment and its factualization, I am able to "break" a fact f into "simpler" fact(s) and use these "simpler" fact(s) to ground f. Thereby, the grounding relation is irreflexive, as intended.

Second, the determination relation, as I propose, is non-factive. For example, the property [λFa]'s obtaining determines the property [λ¬Fa]'s not obtaining. This determination relation holds, no matter whether the property [λFa] actually obtains or not.

In this respect, determination functions similar to Audi's (2012) appropriate to grounding and Fine's (2012) non-factive grounding. On my view, we should define determination, non-factive grounding, or some other non-factive grounding-related notion first, and then define factive metaphysical grounding in terms of it. As Fine (2012) claims, the fact of there being a philosopher knows nothing of Socrates. It appears that we should distinguish how a fact is grounded from what the fact is actually grounded in. No doubt, the fact of there being a philosopher is grounded in the fact of Socrates' being a philosopher. But how the fact is grounded only depends on its being an existential fact, having nothing to do with who happens to be a philosopher. Defining a non-factive grounding-related notion first allows us to separate these two factors.

Besides that, as we will see, we are able to remove irrelevant facts and address grounding overdetermination with non-factive grounding-related notions.

Finally, I take determination to be a relation between assignments, which can be represented in set theory. Plausibly, states of affairs can do the job too. However, as will be clear, set-theoretic operations are helpful in formulating my account. Hence, I prefer assignments to states of affairs.

This section is only concerned with what determines logically constructed nullary properties' obtaining or not obtaining. In the next two sections, I will turn to predicational nullary properties.

Let me introduce a few terminologies first. As we have observed in Chapter 2, properties can be constituted by logical constructions, expansion, and predication. Hence, constituted properties can be classified by their constitution. Let us start with the stipulation that (an occurrence of) an entity immediately constitutes a property P if and only if it constitutes P and it does not constitute any constituents of P. I call it "an immediate constituent of P."

(Here, I add "(an occurrence of)" because an entity may have two occurrences, one of which immediately constitutes P and the other constitutes a constituent of P. [λFa] in [λ((Fa and Gb) or Fa)] is a case in point.)

Given the notion of immediate constitution, we are able to classify constituted properties as follows. Let us call a property "logically constructed" if and only if it is immediately constituted by logical constructions; a property "expansional" if and only if it is immediately constituted by expansion; a property "predicational" if and only if it is immediately constituted by predication. "a negative property", "a conjunctive property", "a disjunctive property", "a conditional property", "a

biconditional property", "a general property", "a universal property", and "an existential property" can be defined in familiar ways.

Now let us focus on nullary properties. Intuitively, a nullary property's obtaining or not obtaining is determined by other nullary properties' obtaining or not obtaining. Consider logically constructed nullary properties first. Take the negative nullary property of a's not being F for example. Its obtaining or not obtaining is determined as follows:

…	determines …
[λFa]'s obtaining	[λ¬Fa]'s not obtaining
[λFa]'s not obtaining	[λ¬Fa]'s obtaining

Turn to the conjunctive nullary property of a's being F and b's being G. Its obtaining or not obtaining is determined as follows:

…	and …	determine …
[λFa]'s obtaining	[λGb]'s obtaining	[λ(Fa and Gb)]'s obtaining
[λFa]'s obtaining	[λGb]'s not obtaining	[λ(Fa and Gb)]'s not obtaining
[λFa]'s not obtaining	[λGb]'s obtaining	[λ(Fa and Gb)]'s not obtaining
[λFa]'s not obtaining	[λGb]'s not obtaining	[λ(Fa and Gb)]'s not obtaining

Then turn to the disjunctive nullary property of a's being F or b's being G. Its obtaining or not obtaining is determined as follows:

…	and …	determine …
[λFa]'s obtaining	[λGb]'s obtaining	[λ(Fa or Gb)]'s obtaining
[λFa]'s obtaining	[λGb]'s not obtaining	[λ(Fa or Gb)]'s obtaining
[λFa]'s not obtaining	[λGb]'s obtaining	[λ(Fa or Gb)]'s obtaining
[λFa]'s not obtaining	[λGb]'s not obtaining	[λ(Fa or Gb)]'s not obtaining

A few examples may help. The negative nullary property [λ(Socrates is not a bachelor)]'s obtaining is determined by [λ(Socrates is a bachelor)]'s not obtaining. The conjunctive nullary property [λ(Socrates is wise and Plato is strong)]'s obtaining is determined by [λ(Socrates is wise)]'s obtaining and [λ(Plato

is strong)]'s obtaining. It is easy to see that all the above examples of determination parallel to the truth-tables of logical operations.

Now let me introduce the notion of assignment. Take any nullary property P. We can either assign the value of obtaining or the value of not obtaining to P. Let us call P's (not) obtaining "an assignment of P." The two possible assignments of P can be represented by the following two tuples: <P, obtaining> and <P, not obtaining>.

The idea can be naturally extended to a set S of nullary properties. We can assign either obtaining or not obtaining to all and only properties in S. Let us call it "an assignment of S." (I will also call it "an assignment of the properties P, Q, …", where P, Q, … are all and only members of S.) An assignment of S can be represented by a set of tuples.

Let us take an assignment A of a set S of nullary properties and call a nullary property P's (not) obtaining "a member of A" if and only if P is a member of S and A assigns the value of (not) obtaining to P.

Since negative, conjunctive, or disjunctive nullary properties must have nullary properties as their immediate constituents, it follows that to talk about their immediate constituents' obtaining or not obtaining makes sense.

Given the above discussion, in general, we have it that (i) a negative nullary property's obtaining is determined by its immediate constituent's not obtaining, while its not obtaining is determined by its immediate constituent's obtaining; (ii) a conjunctive nullary property's obtaining is determined by its immediate constituents' obtaining, while its not obtaining is determined by any of the other

assignments of its immediate constituents; and (iii) a disjunctive nullary property's not obtaining is determined by its immediate constituents' not obtaining, while its obtaining is determined by any of the other assignments of its immediate constituents.

Now let me introduce the notion of determinant assignment. Take any arbitrary nullary property P. Let us call an assignment "a determinant assignment of P's (not) obtaining" if and only if the assignment determines P's (not) obtaining. Intuitively, the conditional nullary property [λ(if Fa, then Gb)]'s (not) obtaining and [λ(¬Fa or Gb)]'s (not) obtaining have the same determinant assignment(s); and the biconditional nullary property [λ(Fa if and only if Gb)]'s (not) obtaining and [λ((Fa and Gb) or (¬Fa and ¬Gb))]'s (not) obtaining have the same determinant assignments.

In general, we have it that (i) a conditional nullary property's not obtaining is determined by its antecedent's obtaining and its consequent's not obtaining, while its obtaining is determined by any of the other assignments of its antecedent and its consequent; and (ii) a biconditional nullary property's obtaining is determined by any of the assignments that assign the same value to its immediate constituents, while its not obtaining is determined by any of the assignments that assign different values to its immediate constituents.

For example, the conditional nullary property [λ(if Socrates is wise, then Plato is strong)]'s not obtaining is determined by [λ(Socrates is wise)]'s obtaining and [λ(Plato is strong)]'s not obtaining.

(Here, the terms "antecedent" and "consequent" are borrowed from basic logic. Right now, they are understood as immediate constituents of conditional properties, not as sub-expressions of conditional formulas.)

The notion of determination also applies to general nullary properties' obtaining or not obtaining. Take the universal nullary property of everything's being F for example. Given the above discussion of conjunction, it is natural to take its obtaining or not obtaining as so determined:

…	determine …
[λFa]'s obtaining, [λFb]'s obtaining, …	[λ∀xFx]'s obtaining
Any of the other assignments of [λFa], [λFb], …	[λ∀xFx]'s not obtaining

Take the existential nullary property of something's being F for example. Given the above discussion of disjunction, it is natural to take its obtaining or not obtaining as so determined:

…	determine …
[λFa]'s not obtaining, [λFb]'s not obtaining, …	[λ∃xFx]'s not obtaining
Any of the other assignments of [λFa], [λFb], …	[λ∃xFx]'s obtaining

Here, a, b, … are all the objects. (As we will see, taking the totality fact of a, b, …'s being all the objects as a condition of determination instead of a part of determinant has significant import: it leads to the failure of the entailment principle of metaphysical grounding. I will discuss this issue later.)

Let us generalize. Take any general property P. Let me stipulate that a specification of the immediate constituent of P is a property constituted by predicating P's immediate constituent of an object. Here, the immediate constituent of P is just the property being immediately generalized in P. For example, [λ(Socrates is wise)] is a specification of the immediate constituent

[λx(x is wise)] of [λ∃x(x is wise)] because it is constituted by predicating [λx(x is wise)] of Socrates.

Since all the specifications of the immediate constituent of a general nullary property must be nullary, it follows that to talk about these specifications' (not) obtaining makes sense.

Given the above discussion, in general, we have it that (i) a universal nullary property's obtaining is determined by all the specifications of its immediate constituent's obtaining, while its not obtaining is determined by any of the other assignments of all the specifications of its immediate constituent; and (ii) an existential nullary property's not obtaining is determined by all the specifications of its immediate constituent's not obtaining, while its obtaining is determined by any of the other assignments of all the specifications of its immediate constituent.

So far, I have gone over all logically constructed nullary properties and specify determinant assignments for their obtaining or not obtaining. This account of determination is partial because it does not cover predicational nullary properties. I will address this issue in the next two sections.

III. The Construction-Predication Case and Determinant Assignment

There are other constituted nullary properties whose obtaining or not obtaining are determined. As we know, constituted properties are either logically constructed, expansional or predicational. Given that no expansional properties are nullary, let us now focus on predicational nullary properties.

Obviously, any predicational nullary property is immediately constituted by predicating a property of an object or a property. I call the property being predicated "immediately constituent predicate," and the object or the property of which the aforementioned property is predicated "immediately constituent subject". Clearly, if a predicational nullary property's obtaining or not obtaining is determined, it is determined in virtue of its immediately constituent predicate or in virtue of its immediately constituent subject.

Let us consider the immediately constituent predicate first. It can be further classified as (i) a logically constructed property, (ii) an expansional property, or (iii) a distinct predicational property. I call the first case "the construction-predication case", the second case "the expansion-predication case", and the last case "the predication-predication case."

For example, [λ(Plato is wise and strong)] is a construction-predication case because it is constituted by predicating the conjunctive property [λx(x is wise and strong)] of Plato. [λ(Plato is such that Socrates is wise)] is an expansion-predication case because it is constituted by predicating the expansional property [λx(x is such that Socrates is wise)] of Plato. Suppose that [λ(Socrates is Plato's teacher)] is constituted by predicating of Socrates [λx(x is Plato's teacher)], which in turn is constituted by predicating of Plato [λyλx(x is y's teacher)]. Then it is a predication-predication case. In this section, I will only discuss the construction-predication case. I will discuss the other two cases in the next section.

Take the predicational nullary property P of a's being such that it is F and b is G for example. It is a construction-predication case because P is immediately

constituted by predicating the conjunctive unary property [λx(Fx and Gb)] of a. Intuitively, P's (not) obtaining and [λ(Fa and Gb)]'s (not) obtaining have the same determinant assignment(s). That is, P's obtaining is determined by [λFa]'s obtaining and [λGb]'s obtaining, while its not obtaining is determined by any of the other assignments of [λFa] and [λGb].

Let us call [λFa] and [λGb] "the predication results" of [λxFx] and [λxGb] respectively, which are the immediate constituents of the conjunctive unary property [λx(Fx and Gb)]. Hence, P's obtaining is determined by the obtaining of the predication results of the immediate constituents of [λx(Fx and Gb)], while its not obtaining is determined by any of the other assignments of the predication results of the immediate constituents of [λx(Fx and Gb)].

For example, [λ(Socrates is such that he is wise and Plato is strong)]'s obtaining is determined by [λ(Socrates is wise)]'s obtaining and [λ(Plato is strong)]'s obtaining. Here, [λ(Socrates is wise)] is the predication result of [λx(x is wise)], which is an immediate constituent of the conjunctive unary property [λx(x is wise and Plato is strong)].

In general, if a predicational nullary property is immediately constituted by a conjunctive unary property, then (i) its obtaining is determined by the obtaining of the predication results of the immediate constituents of the conjunctive unary property, and (ii) its not obtaining is determined by any of the other assignments of the predication results of the immediate constituents of the conjunctive unary property. Obviously, this account can be generalized to all other construction-

predication cases, and all the construction-predication-predication-… cases as well, like the property of a and b's being x and y such that x is F and y is G.

Now let me provide a precise formulation. Let us start with the notion of constitution trace. Suppose that (an occurrence of) a property P_1 constitutes the property P. In this case, we can define the constitution trace CT of P_1 as follows: CT is a sequence with P_1 as its first element and P as its last element, and for any n, the nth element P_n of CT immediately constitutes its succeeding element P_{n+1}. Let us call an element in CT "a predicational element" if and only if the element is immediately constituted by predication. Also, let us stipulate that an element P_n is closer to P_m than P_r is if and only if m is less than n and n is less than r.

With the above stipulations, we are able to define the notion of predication trace. A predication trace PT of (an occurrence of) a property is also a sequence with the property as its first element Q_1. (To distinguish predication trace from constitution trace, I will use "Q" with numerical subscripts to stand for elements of PT.)

Take the above P_1 again for example. In its PT, the first element Q_1 is P_1. The second element Q_2 is the property constituted by predicating Q_1 of an entity, if P_1's closest predicational element in its CT is constituted by predicating its preceding element of the entity. In general, for any n, the nth element Q_n is the property constituted by predicating its preceding element Q_{n-1} of an entity, if P_1's n-1th closest predicational element in its CT is constituted by predicating its

preceding element of the entity. (If P_1 has no succeeding predicational elements in CT, then its predication trace has only one element P_1.)

A concrete example may help. As we know, the property of being wise constitutes the property of Socrates' being such that he is wise and Plato is strong. In this case, the constitution trace CT of the property of being wise is the sequence <the property of being wise, the property of being such that x is wise and Plato is strong, the property of Socrates' being such that x is wise and Plato is strong>. In this CT, the closest predicational element of P_1 is P_3, which is constituted by predicating its preceding element of Socrates. Hence, the predication trace PT of the property of being wise is the sequence <the property of being wise, the property of Socrates' being wise>, where its Q_2 is constituted by predicating its preceding element of Socrates.

(It is easy to notice from the above example that P_1's closest predicational element may not be P_2. Hence, it could be the case that P_1's closest predicational element is constituted by predicating its preceding element of a, but that has nothing to do with P_1 *per se*. In this case, Q_2 is just Q_1. For example, suppose that P_1 is $[\lambda y(y \text{ is wise})]$ and its closest predicational element is constituted by predicating $[\lambda x \lambda y(y \text{ is wise and } x \text{ is strong})]$ of Plato. In this case, Q_2 in the predication trace is still $[\lambda y(y \text{ is wise})]$.)

Recall that I call $[\lambda Fa]$ "the predication result" of $[\lambda x Fx]$ in the previous example. With the notion of predication trace, I am able to define the notion of predication result.

Since the constitution trace CT of P_1 has P as its last element, so the predication trace PT of P_1 must also have its last element. After all, if all elements except P_1 in CT are predicational, then PT will have P as its last element; not to mention cases in which some succeeding elements of P_1 in CT are not predicational. I call the last element of PT "the predication result of P_1." (If P_1 has no succeeding predicational elements in CT, then its predication result is just P_1.)

With such long but necessary preliminaries, let us now return to the construction-predication cases.

It should be noted that, in the above definitions of constitution trace and predication trace, I do not presuppose that the last element of a constitution trace must be nullary. However, in the construction-predication cases, I am concerned with predicational nullary properties each of which is immediately constituted by predicating a logically constructed property of an entity. Hence, all the immediate constituents of the logically constructed property have the same last element in their constitution traces, which is the predicational nullary property itself. If so, then all the immediate constituents of the logically constructed property must have nullary predication results. It follows that to talk about these predication results' (not) obtaining makes sense. Obviously, that can be generalized to all the construction-predication-predication-… cases.

In addition, let us define "a nullary predication result of a property" as follows. Take any property P_1. If P_1 is nullary, then its nullary predication result is just P_1. If P_1 is unary, then its nullary predication result is a property constituted by predicating P_1 of an entity. In general, for any n, if P_1 is n-ary, then its nullary

predication result is a property constituted by predicating P_1 of n entities. (I will use "NPR" as a convenient shorthand for "nullary predication result.") As we will see, with this notion, I am able to offer the principles of determination that apply to all the construction-predication-predication-… cases.

Given the above, if P is a nullary predication result of a logically constructed property P_1, then the predication result(s) of P_1's immediate constituent(s) are also nullary. I call them "the NPR(s) of P_1's immediate constituent(s)."

Given the above stipulations and discussions, we have the following principles of determination:

Names	Principles of Determination	
(Neg)	If P is an NPR of a negative property P_1, then	(i) P's obtaining is determined by the assignment A which is the NPR of P_1's immediate constituent's not obtaining, while (ii) P's not obtaining is determined by the assignment A which is the NPR of P_1's immediate constituent's obtaining.
(Conj)	If P is an NPR of a conjunctive property P_1, then	(i) P's obtaining is determined by the assignment A which is the NPRs of P_1's immediate constituents' obtaining, while (ii) P's not obtaining is determined by any A of the other assignments of the NPRs of P_1's immediate constituents.
(Disj)	If P is an NPR of a disjunctive property P_1, then	(i) P's not obtaining is determined by the assignment A which is the NPRs of P_1's immediate constituents' not obtaining, while (ii) P's obtaining is determined by any A of the other assignments of the NPRs of P_1's immediate constituents.
(Cond)	If P is an NPR of a conditional property P_1, then	(i) P's not obtaining is determined by the assignment A which is the NPRs of P_1's immediate constituents' not obtaining, while (ii) P's obtaining is determined by any A of the other assignments of the NPRs of P_1's immediate constituents.
(Bicond)	If P is an NPR of a biconditional	(i) P's obtaining is determined by any A of the assignments that assign the same value to the NPRs of P_1's immediate constituents, while

	property P_1, then	(ii) P's not obtaining is determined by any A of the assignments that assign different values to the NPRs of P_1's immediate constituents.
(Univ)	If P is an NPR of a universal property P_1, then	(i) P's obtaining is determined by the assignment A which is all the specifications of the NPR of P_1's immediate constituent's obtaining, while (ii) P's not obtaining is determined by any A of the other assignments of all the specifications of the NPR of P_1's immediate constituent.
(Exist)	If P is an NPR of an existential property P_1, then	(i) P's not obtaining is determined by the assignment A which is all the specifications of the NPR of P_1's immediate constituent's not obtaining, while (ii) P's obtaining is determined by any A of the other assignments of all the specifications of the NPR of P_1's immediate constituent.

To illustrate (Exist), take the predicational nullary property P of a's being such that it stands in R to something for example. It is a construction-predication case because P is constituted by predicating the existential property [λx∃yRxy] of a. Obviously, P is an NPR of [λx∃yRxy]. Let us consider what determines P's not obtaining. In this case, the immediate constituent of the existential property is [λxλyRxy], and its NPR is [λyRay]. Then, its specifications are [λRaa], [λRab], …, where a, b, … are all the objects. Given (Exist), P's not obtaining is, as intended, determined by all these specifications' not obtaining.

The above principles of determination not only apply to the construction-predication cases, but also apply to all logically constructed nullary properties as discussed in the previous section. Take the conjunctive nullary property [λ(Socrates is wise and Plato is strong)] for example. As I have previously claimed, if a property is nullary, then its nullary predication result is still the property. Since the conjunctive property [λ(Socrates is wise and Plato is strong)]

is nullary, its NPR is still the very same property. The antecedent of (Conj) is thereby satisfied.

Turn to the consequent of (Conj). One of the immediate constituents of the conjunctive property is [λ(Socrates is wise)]. And it has no succeeding predicational element in its constitution trace. As I have previously claimed, if a property has no succeeding predicational elements in its constitution trace, then its predication result is still the property. So, the NPR of [λ(Socrates is wise)] is still the property. The same can be said of the other immediate constituent [λ(Plato is strong)]. Applying (Conj), we get the intended result: [λ(Socrates is wise)]'s obtaining and [λ(Plato is strong)]'s obtaining determine [λ(Socrates is wise and Plato is strong)]'s obtaining. That shows that the above principles of determination are applicable to logically constructed nullary properties.

IV. Other Cases and Determinant Assignment

So far, I have discussed the construction-predication cases. Now turn to expansion-predication cases. Take the predicational nullary property of a's being such that b is G for example. It is an expansion-predication case because it is constituted by predicating an expansional property [λxGb] of a. Intuitively, its obtaining is determined by [λGb]'s obtaining and [λ∃x(x=a)]'s obtaining, while its not obtaining is determined by [λGb]'s not obtaining and [λ∃x(x=a)]'s obtaining.

Then consider an expansion-predication-predication case: the predicational nullary property of a and b's being x and y such that y is G. Intuitively, its

obtaining or not obtaining is also determined by [λGb]'s obtaining or not

obtaining, together with [λ∃x(x=a)]'s obtaining and [λ∃x(x=b)]'s obtaining. In this

case, [λGb] is the NPR of the immediate constituent [λyGy] of the relevant

expansional property [λxλyGy]. And a and b are the subjects being predicated of

in the constitution of the predicational nullary property by the expansional

property. Obviously, this account can be generalized to all the expansion-

predication-predication-… cases.

Again, since the immediate constituent of the expansional property has a

nullary property as the last element in its constitution trace, so the immediate

constituent of the expansional property must have a nullary property as its

predication result. It follows that to talk about the predication result's (not)

obtaining makes sense.

Given the above discussion, in general, we have

Name	Principle of Determination	
(Exp)	If P is an NPR of an expansional property P_1, then	P's (not) obtaining is determined by the assignment A which is the NPR of P_1's immediate constituent's (not) obtaining, [λ∃x(x=a)]'s obtaining, [λ∃x(x=b)]'s obtaining, …

Here, a, b, … are all the subjects being predicated of in the constitution of P

by P_1. Again, (Exp) not only applies to cases in which the immediate constituent

of P_1 is not nullary, but also applies to cases in which the immediate constituent

of P_1 is nullary. A case in point is that P is the property of Socrates' being such

that Plato is strong.

Now turn to the predication-predication cases. Since I have offered the

principles of determination for all construction-predication-predication-… cases

and all expansion-predication-predication-… cases, the only remaining cases are predicational nullary properties each of which is constituted by predicating a simple property of n objects or properties. That is, the predication-predication-… cases.

If one or more than one of the n objects or properties here is not fundamental or simple, then the predicational nullary property's obtaining or not obtaining is determined in virtue of them. I will discuss these cases later.

Assume otherwise that the predicational nullary property P is constituted by predicating a simple property of n objects or properties, where all the objects are fundamental and all the properties are simple. Can P's obtaining or not obtaining be determined?

I only find one such case. The instantiation property is plausibly a simple property. If so, then predicating the instantiation property of n objects or properties is a case in point. For example, the predicational nullary property $[\lambda(a$ instantiates the property of being F)]'s (not) obtaining is determined by the predicational nullary property $[\lambda Fa]$'s (not) obtaining. Here, $[\lambda(a$ instantiates the property of being F)] is constituted by predicating the instantiation property of a and the property of being F.

Given that obtaining is a special case of instantiation, we also have it that the predicational nullary property $[\lambda(P_1$ obtains)]'s (not) obtaining is determined by P_1's (not) obtaining. Here, P_1 can be any nullary property.

Let us generalize. In Chapter 2, I call the formula "a instantiates the property of being F" "a Δ-conversion" of the formula "a is F." Parallel to the Δ-conversion

between formulas, let us call P "a deltification of a property P_1" if and only if (i) if P_1 is immediately constituted by predicating the property of being F of an entity, then P is immediately constituted by predicating the instantiation property of the property of being F and the entity; and (ii) if P_1 is a nullary property, then P is immediately constituted by predicating the obtaining property of P_1.

The notion of deltification naturally applies to properties constituted by deltifications. For example, if P is a deltification of P_1, then the negation of P is a deltification of the negation of P_1; if P is P_1's deltification, Q is Q_1's deltification, then the conjunction of P and Q is a deltification of the conjunction of P_1 and Q_1. The property of being such that b instantiates the property of being G is a deltification of the property of being such that b is G because the property of b's instantiating the property of being G is a deltification of the property of b's being G. And if P is a deltification of P_1, then the property of a's being P is a deltification of the property of a's being P_1.

(One property may thereby have more than one deltifications. For example, both the negative property of [λ(Socrates does not instantiate the property of being wise)] and the positive property of [λ(Socrates is not wise)]'s obtaining are deltifications of the negative nullary property [λ(Socrates is not wise)]. Hence, a negative property may have a positive property as its deltification. Nevertheless, it can be shown that only a negative property's deltification can be a negative property.)

The notion of deltification can be extended to sets of properties. Take any two sets, S and T, of properties. S is T's deltification if and only if (i) for any member y

of T, there is one and only one member x of S such that x is y's deltification; and

(ii) for any member x of S, there is one and only one member y of T such that x is

y's deltification.

We know that if a predicational property is not nullary, then its deltification is

also not nullary. It follows that if a predicational nullary property P is a deltification

of P_1, then P_1 must also be nullary. Hence, to talk about P_1's obtaining or not

obtaining makes sense.

Given the above discussion, in general, we have

Name	Principle of Determination	
(Delt)	If the predicational nullary property P is a deltification of P_1, then	P's (not) obtaining is determined by the assignment A which is P_1's (not) obtaining.

Obviously, it recursively applies to iterated deltification cases.

In addition, intuitively, if a nullary property P's obtaining is determined by a

nullary property Q's obtaining, then P's deltification's obtaining is determined by

Q's deltification's obtaining. For example, if [λ(Socrates is wise and Plato is

strong)]'s obtaining is determined by [λ(Socrates is wise)]'s obtaining and [λ(Plato

is strong)]'s obtaining, then [λ(Socrates instantiates the property of being wise

and Plato instantiates the property of being strong)]'s obtaining is determined by

[λ(Socrates instantiates the property of being wise)]'s obtaining and [λ(Plato

instantiates the property of being strong)]'s obtaining. Obviously, we need a

general principle to accommodate this case. I call it "the principle of

determination ascent."

Intuitively, the converse is also true. That is, if a nullary property P's

deltification's obtaining is determined by a nullary property Q's deltification's

obtaining, then P's obtaining is determined by Q's obtaining. Let us call the

principle to accommodate this case "the principle of determination descent."

Let us stipulate that an assignment A is a deltification of an assignment B if

and only if (i) if B assigns the value of (not) obtaining to a nullary property, then A

assigns the value of (not) obtaining to its deltification, and (ii) nothing else is A's

member.

In general, we have

Names	Principles of Determination
(Det-a)	If a nullary property Q's (not) obtaining is determined by an assignment B, P is a deltification of Q, and A is a deltification of B, then P's (not) obtaining is determined by the assignment A.
(Det-d)	If a nullary property Q's (not) obtaining is determined by an assignment B, Q is P's deltification, and B is A's deltification, then P's (not) obtaining is determined by the assignment A.

(It should be noted that (Det-a) and (Det-d) are not entailed by (Delt). If the

nullary property [λFa]'s obtaining determines the nullary property [λGb]'s

obtaining, by (Delt) and transitivity, we can derive that [λFa]'s obtaining also

determines [λ(b instantiates the property of being G)]'s obtaining. However, we

cannot derive that [λ(a instantiates the property of being F)]'s obtaining

determines [λ(b instantiates the property of being G)]'s obtaining. Therefore, we

need (Det-a) and (Det-d) in addition to (Delt).)

So far, I have gone over all types of predicational nullary properties and put

forward a few principles of determination for them guided by our intuitions about

determination. Suppose that by repeatedly applying these principles of

determination, we finally get a determinant assignment which assigns obtaining

or not obtaining to a set of nullary properties. Obviously, these nullary properties

cannot be logically constructed: if one of them is logically constructed, then we can apply the above principles of determination and get a further determinant assignment without the logically constructed nullary property. So, they must be predicational. Intuitively, these predicational nullary properties' obtaining or not obtaining may be further determined in virtue of their immediately constituent subjects. Let me now consider how they are so determined.

As I have argued in Chapter 2, the property of being a can be identical with the property of being the F. If so, then the nullary property of a's being G is identical with the nullary property of the F's being G. It follows that their obtaining or not obtaining have the same determinant assignments. The same can be said of the nullary property of b's being a and the nullary property of b's being the F.

But what determines [λ(the F is G]]'s obtaining or not obtaining? And what determines [λ(b is the F)]'s obtaining or not obtaining? If Russellian theory of definite descriptions is right, then the property of the F's being G is identical with the property [λ(∃x(Fx, Gx, and ∀y(if Fy, then y=x)))]; and the property of b's being the F is identical with the property [λ(∃x(Fx, b=x, and ∀y(if Fy, then y=x)))]. They are not genuine predicational nullary properties, but disguised existential nullary properties. Hence, the above principles of determination readily apply.

If Fregean theory of definite descriptions is right, then the property of the F's being G is constituted by predicating [λxGx] of [λxDx][λxFx], which is in turn constituted by predicating [λxDx] of [λxFx]. In this case, predicating [λxDx] of [λxFx] returns the object a. If so, then the above principles of determination are not applicable.

On my view, the semantic question whether definite descriptions are names can be separated from the metaphysical question what determines [λ(the F is G)]'s obtaining or not obtaining. According to Fregean theory, the predicational nullary property [λ(the F is G)] is distinct from the existential nullary property [λ(∃x(Fx, Gx, and ∀y(if Fy, then y=x)))]. However, we can still take their obtaining or not obtaining as having the same determinant assignments. If otherwise, what else could possibly determine [λ(the F is G)]'s obtaining or not obtaining? The same can be said of [λ(b is the F)] and [λ(∃x(Fx, b=x, and ∀y(if Fy, then y=x)))].

It should be noted that a determinant assignment of [λ(∃x(Fx, Gx, and ∀y(if Fy, then y=x)))]'s (not) obtaining may have [λ(the F is G)]'s (not) obtaining or [λ(a is G)]'s (not) obtaining as its member. Let us rule out such determinant assignments. This move is not ad hoc because we want to make sure that determination is irreflexive.

In general, we have

Name	Principle of Determination
(Desc)	(i) If P is the nullary property [λ(the F is G)], the nullary property [λ(∃x(Fx, Gx, and ∀y(if Fy, then y=x)))]'s (not) obtaining is determined by an assignment A, and P's (not) obtaining ∉ A, then P's (not) obtaining is also determined by A, and (ii) if P is the nullary property [λ(b is the F)], the nullary property [λ(∃x(Fx, b=x, and ∀y(if Fy, then y=x)))]'s (not) obtaining is determined by an assignment A, and P's (not) obtaining ∉ A, then P's (not) obtaining is also determined by A.

Let me call the clause "P's (not) obtaining ∉ A" "the irreflexivity clause." As it turns out, imposing the irreflexivity clause amounts to requiring [λxFx] or [λxGx] to be constituted properties. In other words, if both of them are simple, then nothing determines [λ(the F is G)]'s (not) obtaining.

As we will see, from the irreflexivity clause, we can derive that some facts about property consitution are plausibly ungrounded (under the assumption that some notion(s) about property constitution are simple properties). This is important in addressing the meta-grounding problem.

A difficult issue arises from predication modification. If every predication modification boils down to conjunction, then we do not need any further principles. However, not all predicate modifiers are intersective, for example, "skillful" and "alleged." To address this issue, we may need some further principle(s) of determination. Frankly, I do not know what the relevant principle(s) of determination look like. Let me bracket this issue for now.

Finally, we need the principle of transitivity to accommodate the determination of [λ(¬Fa and Gb)]'s obtaining by [λFa]'s not obtaining and [λGb]'s obtaining.

Suppose that A is an assignment of a set S of nullary properties. Let us call a nullary property P's (not) obtaining "a member of A" if and only if P is a member of S and A assigns the value of (not) obtaining to P. With the notion of membership, we can define set-theoretic operations on assignments in familiar ways. Then we have

Name	Principle of Determination
(Trans)	If a nullary property P's (not) obtaining is determined by an assignment A`, and a member m of A` is determined by an assignment A``, then P's (not) obtaining is also determined by the assignment A which is A`∪A``−{m}.

Here, "A`∪A``−{m}" stands for the assignment having all and only members of A` and A`` except for the member m.

Let us take stock. We have it that:

(DET) A nullary property P's (not) obtaining is determined by an assignment A

if and only if P and A are such that (Neg), (Conj), (Disj), (Cond),

(Bicond), (Univ), (Exist), (Exp), (Delt), (Det-a), (Det-d), (Desc) and

(Trans).

Clearly, the principles from (Neg) to (Delt) only allow P's (not) obtaining to be

determined by assignments of properties "simpler" than P. (Here, let us assume

that [λFa] is "simpler" than [λ∃xFx].) The remaining principles are used to derive

determination assignments from determination assignments. It can be shown that

they do not undermine the claim that P's (not) obtaining is determined by

assignments of properties "simpler" than P.

I leave open the question whether there are any further principles of

determination. If there are, then (DET) should be modified accordingly.

Once we have the determination of P's (not) obtaining by an assignment A,

we can extend the notion of determination by the principle of additivity (Add):

Name	Principle of Determination
(Add)	(i) If a nullary property P's obtaining is determined by an assignment A, then the assignment {P's obtaining}∪A` is determined by A∪A`, and (ii) if a nullary property P's not obtaining is determined by an assignment A, then the assignment {P's not obtaining}∪A` is determined by A∪A`.

Here, "A∪A`" stands for the assignment having all and only members of A and

A`. An example of (Add) is that if a nullary property P's obtaining is determined

by Q's obtaining, then the assignment {P's obtaining, R's obtaining} is

determined by the assignment {Q's obtaining, R's obtaining}.

V. The Grounding Relation and Factualization of Determinant Assignment

The aim of section V and VI is to offer an account of metaphysical grounding with the notion of determination and its factualization. Here, metaphysical grounding is understood as a relation. Let me introduce the grounding relation first.

As we know, there are two different formulations of metaphysical grounding (Correia & Schnieder, 2012). The operational formulation uses instances of the schema "φ because ψ" or the schema "φ because Γ" to express metaphysical grounding. All the examples provided in section I are formulated in this way. In contrast, the relational formulation uses instances of the schema "the fact of b's being Y grounds the fact of a's being X" or the schema "a set S of facts grounds the fact of a's being X." (I will also use "the facts f_1, f_2, f_3, … ground the fact of a's being X" for convenience.)

The relational formulation has higher expressive power. Only the relational formulation allows us to express that the identity of metaphysical grounding is determined by the identities of its relata. That is, for any facts f_1, f_2, f_3, f_4, if f_1 grounds f_2, f_3 grounds f_4, f_1 is f_3, and f_2 is f_4, then the metaphysical grounding of f_2 by f_1 is the metaphysical grounding of f_4 by f_3. Hence, in addition to the operational formulation, it is legitimate to use and take seriously the relational formulation, and hence the grounding relation.

It is a received view that if metaphysical grounding is a relation, then facts are its relata (Fine. 2012; Rosen, 2010). There is a general concern about this view.

If relata of metaphysical grounding are facts, does it preclude there being cases of metaphysical grounding about facts? Obviously not. For example, we can take some facts to ground the fact of there being the fact of a's being X. This is a case of metaphysical grounding about the fact of a's being X.

As is suggested by the above example (n), the fact of there being the fact of a's being X has different grounds from the fact of a's being X. The former fact is plausibly grounded in facts about property constitution and property instantiation, while the latter fact is not so grounded.

Now if facts are relata of metaphysical grounding, then what facts are related by the grounding relation? Let me first consider the cases in which the operational grounding claim "a is X because b is Y" is true and it has corresponding true factive real definition statement "for a to be X is for b to be Y." I will consider the remaining cases in the next section.

We can see that in the cases in which "for a to be X is for b to be Y" is a true factive real definition statement, the fact of b's being Y does not ground the fact of a's being X. Suppose for reduction that the fact of b's being Y grounds the fact of a's being X. Given that metaphysical grounding is irreflexive, it follows that the fact of a's being X is distinct from the fact of b's being Y (Audi, 2012). However, as I have argued in Chapter 2, property identity is a necessary condition for a real definition statement to be true. If "for a to be X is for b to be Y" is a true factive real definition statement, then the obtaining nullary property of a's being X is identical with the obtaining nullary property of b's being Y. That leads to

contradiction. Hence, in this case, it is not true that the fact of b's being Y grounds the fact of a's being X.

As a corollary, it is not true that if "a is X because b is Y" is a true operational grounding claim, then the fact of b's being Y grounds the fact of a's being X. For example, the above (b) is a true operational grounding claim. However, the fact of the molecule composed of H_1, H_2, and O being bonded's having a positive pole does not ground the fact of M's having a positive pole. They are the same fact.

In short, we face a dilemma: if we adopt the relational formulation, then some true operational grounding claims cannot be reformulated in terms of the grounding relation; if we reject the relational formulation, then we lose expressive power.

I propose to grasp the first horn of the dilemma. In the cases in which "for a to be X is for b to be Y" is a true factive real definition statement, we cannot let the fact of b's being Y ground the fact of a's being X. But we can "break" the fact of a's being X into "simpler" fact(s) and let them ground it.

Take the disjunctive fact of a's being F or b's being G for example. As I argued before, it is identical with the obtaining nullary property of a's being F or b's being G. As we know, this disjunctive nullary property's obtaining is determined by three different assignments (A_1) $[\lambda Fa]$'s obtaining and $[\lambda Gb]$'s obtaining, (A_2) $[\lambda Fa]$'s obtaining and $[\lambda Gb]$'s not obtaining, and (A_3) $[\lambda Fa]$'s not obtaining and $[\lambda Gb]$'s obtaining, while its not obtaining is determined by (A_4) $[\lambda Fa]$'s not obtaining and $[\lambda Gb]$'s not obtaining.

Intuitively, if (A₁) holds true of the world, then the facts [λFa] and [λGb] ground the disjunctive fact; if (A₂) holds true of the world, then the fact [λFa] grounds the disjunctive fact; and if (A₃) holds true of the world, then the fact [λGb] grounds the disjunctive fact.

(At this point, one might wonder why to bother with the real definition statement "for a to be X is for b to be Y", if in the end we "break" the fact of a's being X into "simpler" facts and use them to ground the fact of a's being X. The answer is that the constitution of the fact is shown in the true real definition statement and we "break" a fact in accordance with its constitution.)

Let me provide a precise formulation. I want to introduce the notion of factualization first. With this notion, we can turn an assignment into a set of facts. Let A be an assignment of a set of nullary properties. We can define a set S of nullary properties as follows: (i) if A has P's obtaining as its member, then S has P as its member; (ii) if A has P's not obtaining as its member, then S has P's negation as its member; and (iii) nothing else is S' member. I call this operation "non-obtaining/negation conversion." Applied to the above three assignments, non-obtaining/negation conversion returns three sets of nullary properties, {[λFa], [λGb]}, {[λFa], [λ¬Gb]}, and {[λ¬Fa], [λGb]}. Here, one and only one set has all obtaining members.

Let us call a set of nullary properties "the factualization of an assignment" if and only if (i) applied to the assignment, the non-obtaining/negation conversion returns the set, and (ii) all the members of the set obtain. Obviously, some assignments have no factualization. For example, if a is F and b is G, then the

assignment [λFa]'s not obtaining and [λGb]'s not obtaining has no factualization.

Among the above three assignments (A₁), (A₂), and (A₃), one and only one of

them has factualization (under the assumption that the disjunctive fact [λ(Fa or

Gb)] exists.)

With the notion of determinant assignment and its factualization, let us

stipulate the notion of proto-grounding as follows:

(PG) A set S of obtaining nullary properties proto-grounds an obtaining nullary

property P if and only if (i) S is the factualization of a determinant

assignment of P's obtaining, and (ii) P is not a member of S.

Here, the clause (i) is to ensure that the notion of proto-grounding grasps the

intuitive idea that what P is grounded in *in fact* determines P's obtaining.

The clause (ii) is to ensure that all members of S are "simpler" than P. As we

have observed, principles of determination only allow P's obtaining to be

determined by assignments of properties "simpler" than P. However,

factualization may bring P back. For example, [λ¬Fa]'s obtaining is determined by

[λFa]'s not obtaining. By non-obtaining/negation conversion, it returns {[λ¬Fa]}.

Suppose that a is not F. Then the nullary property [λ¬Fa] obtains. Then, {[λ¬Fa]}

is the factualization of a determinant assignment of [λ¬Fa]'s obtaining. The

clause (ii) rules out such cases. Thereby, all members of S are "simpler" than P,

as intended.

Proto-grounding is "close" to grounding. However, proto-grounding and

grounding are distinct in an important respect: (PG) allows irrelevant facts to

proto-ground a grounded fact. For example, given (Disj), the disjunctive nullary

property [λ(Fa or Gb)]'s obtaining is determined by any of the above (A₁), (A₂), and (A₃). Suppose that a is F and b is not G. In this case, only (A₂) has factualization. By (PG), we can derive that the fact [λFa] and the fact [λ¬Gb] proto-ground the disjunctive fact of a's being F or b's being G. However, in this case, the negative fact [λ¬Gb] is an irrelevant fact.

To define metaphysical grounding, we must remove such irrelevant facts. Note that in the above case the disjunctive fact is grounded in the factualization of (A₂), and also that if [λFa]'s obtaining in (A₂) turns into its not obtaining, then (A₂) turns into (A₄) [λFa]'s not obtaining and [λGb]'s not obtaining, which determines the nullary property [λ(Fa or Gb)]'s not obtaining. In short, if we turn [λFa]'s obtaining into its not obtaining, we hereby turn [λ(Fa or Gb)]'s obtaining into its not obtaining. That explains why it is the fact [λFa] that grounds the disjunctive fact, and the fact [λ¬Gb] is irrelevant.

(Obviously, the way I remove irrelevant facts manifests Schaffer's (2016) slogan: wiggle the ground, and the grounded wiggles. In view of the skeptical challenge from Wilson (2014), Schaffer offers a formalism to argue that metaphysical grounding is a unified phenomenon. I agree with Koslicki (2015) that the prospect of formalist response to skeptical challenge is dim. What I do here is similar to Schaffer's formalism. But my account of metaphysical grounding is not formalist in nature.)

Let us generalize. Take any assignment A of nullary properties. We can define a distinct assignment A` as follows: (i) if A has a member P's obtaining, then A` has a member P's not obtaining, (ii) if A has a member P's not obtaining,

then A` has a member P's obtaining, and (iii) nothing else is A`'s member. Let us call A` "the opposite assignment" of A.

With it, we can define "a partially opposite assignment": A` is a partially opposite assignment of A if and only if (i) there are some member(s) of A such that A` has their opposite(s) as its member(s), (ii) for all the other members of A, A` has them as its members, and (iii) nothing else is A`'s member.

Given the above stipulation and discussion, in general, we have: if the factualization of an assignment A proto-grounds an obtaining nullary property P, and a partially opposite assignment A` of A determines P's not obtaining, then the factualization of A−A` grounds P. With it, we are able to derive grounding from proto-grounding. That is,

(G←) A set S of obtaining nullary properties grounds an obtaining nullary property P, if S is the factualization of the assignment A-A`, where the factualization of A proto-grounds P and the partially opposite assignment A` of A determines P's not obtaining.

Here, "A−A`" stands for the assignment having all members of A without any members of A`. In the above case, A is {[λFa]'s obtaining, [λGb]'s not obtaining}, and A` is {[λFa]'s not obtaining, [λGb]'s not obtaining}. A−A` is, therefore, the singleton {[λFa]'s obtaining}. Its factualization is the fact [λFa], which, as intended, grounds the disjunctive fact of a's being F or b's being G (under the assumption that a is F and b is not G).

There are reasons to believe that (G←) holds. First, (G←) appears to yield intended results: the facts [λFa] and [λGb] ground the fact [λ(Fa and Gb)]; the

facts [λFa] and [λFb] ground the fact [λ∃xFx], if a and b are all the F things; the facts [λFa] and [λ∃x(x=b)] ground the fact [λ(b is such that a is F)]; and the fact [λFa] grounds the fact [λ(a instantiates the property of being F)].

Second, we know that if a constituted nullary property P obtains, then how its constituent properties are distributed in the world determines P's obtaining. By the distribution of a property P_1, I mean the factualization of all the nullary properties constituted by predicating P_1 of something. Among all these facts, some are irrelevant to P's obtaining. For example, the fact [λFc] is irrelevant to the conjunctive property [λ(Fa and Gb)]'s obtaining. By the clause (i) of (PG), I rule out such irrelevant facts. Also, the fact [λ¬Fd] is irrelevant to the existential property [λ∃xFx]'s obtaining. By (G←), I rule out such irrelevant facts. It appears to me that I have let in all relevant facts and ruled out all irrelevant facts. Besides that, by the clause (ii) of (PG), I rule out P itself. Plausibly, if a set S of facts determines a nullary property P's obtaining, all facts in the set are relevant to its obtaining, nothing in the set are irrelevant, and P itself is not a member of S, then S grounds P. It follows that (G←) holds.

(Here, the argument appeals to a notion of determination which allows irrelevant facts to determine P's obtaining. So, it is distinct from the one previously defined.)

VI.   A Full Account of the Grounding Relation

So far, I have proposed and defended (G←). Applying it to the cases in which the operational grounding claim "a is X because b is Y" is true and it has corresponding true factive real definition statement yields intended results.

Now let me turn to the cases in which "a is X because b is Y" is true but it has no corresponding true factive real definition statements. Take "something is F because a is F" and "a has mass because a has 8 kilogram-mass" for example. *Prima facie*, "something is F because a is F" is a true grounding claim, while the corresponding "for something to be F is for a to be F" is not a true factive real definitions statement. (As I have mentioned in Chapter 2, I take "for something to be F" as a special case of the schema "for a to be X.") The same can be said of "a has mass because a has 8-kilogram-mass."

Is (G←) applicable to these cases? Consider the first case "something is F because a is F." Suppose that a and b are all the F things. Given (Exist) and (G←), we can derive that the facts [λFa] and [λFb] ground the existential fact [λ∃xFx]. That is definitely true. But we cannot derive that the fact [λFa] alone grounds the existential fact.

Clearly, we need to extend the current account to cover this case. Note that the facts [λFa] and [λFb] overdeterminate the grounded fact [λ∃xFx]. Hence, if we are able to derive a ground without overdetermination, then we have it that the fact [λFa] alone grounds the grounded fact.

The way to derive a ground without overdetermination is similar to the way to remove irrelevant facts allowed by proto-grounding. Suppose that a and b are all the F things. Then the existential fact [λ∃xFx] is grounded in the factualization of

(A₁) [λFa]'s obtaining and [λGb]'s obtaining. Note that if [λGb]'s obtaining turns into its not obtaining in (A₁), then (A₁) turns into (A₂) [λFa]'s obtaining and [λGb]'s not obtaining, which still determines [λ∃xFx]'s obtaining. In short, if we turn [λGb]'s obtaining into its not obtaining, [λ∃xFx]'s obtaining remains the same. That explains why the fact [λGb] is an overdeterminant.

In general, we have: if the factualization of an assignment A grounds an obtaining nullary property P, and a partially opposite assignment A` of A determines P's obtaining, then the factualization of A∩A` also grounds P. With it, we are able to derive a ground without overdetermination from a ground with overdetermination.

Here, "A∩A`" stands for the assignment having all shared members of A and A`. In the above case, A is {[λFa]'s obtaining, [λGb]'s obtaining}, and A` is {[λFa]'s obtaining, [λGb]'s not obtaining}. A∩A` is, therefore, the singleton {[λFa]'s obtaining}. Its factualization alone, as intended, grounds [λ∃xFx].

So far so good for the first case. Let us turn to the second case: determinable properties. Intuitively, the fact of a's having 8-kilogram-mass grounds the fact of a's having mass. I believe that (G←) is applicable to this case. As Rosen (2010) claims, "for a to have mass is for a to have some determinate mass or other" is a true real definition statement. Hence, the obtaining nullary property of a's having mass is identical with the obtaining nullary property of a's having some determinate mass or other. That is, it is identical with the existential fact [λ(∃x(x is a determinate mass property and a has x))]. Since a cannot have more than one determinate property, by (Disj) and (G←), it is grounded in the fact of a's having

8-kilogram-mass, as intended. And Given (Delt) and (G←), the fact of a's having 8-kilogram-mass is further grounded in the fact of a's weighing 8 kilogram.

(It should be noted that treating determinable properties as such does not commit us to the view that determinable properties are just disjunctive properties. The relation between determinables and determinates is still *sui generis*.)

There are complicated cases. For example, intuitively, the obtaining conjunctive nullary property [λ(a is composed of non-overlapping b and c, b has 3-kilogram-mass, and c has 5-kilogram-mass)] grounds the obtaining nullary property [λ(a has 8-kilogram-mass)]. It is not clear that what I have claimed so far is applicable.

In this case, as I believe, we need to appeal to the principle of grounding descent. That is, if an obtaining nullary property Q is grounded in a set T of facts, Q is P's deltification, T is S' deltification, then P is grounded in S.

Let me derive the principle of grounding descent from the principle of determination descent (Det-d) first. Suppose the antecedent that T grounds Q, Q is P's deltification and T is S' deltification. Let us say, in this case, Q's obtaining is determined by an assignment B, and T is the factualization of B. Suppose that B is {Q_1's obtaining, Q_2's obtaining, …, and Q_m's not obtaining, Q_{m+1}'s not obtaining, …}. Then, T is {Q_1, Q_2, …, and $\neg Q_m$, $\neg Q_{m+1}$, …}. Given that T is S' deltification and that only a negative property's deltification can be a negative property, it follows that Q_1, Q_2, …, and $\neg Q_m$, $\neg Q_{m+1}$, … are deltifications of P_1, P_2, …, and $\neg P_m$, $\neg P_{m+1}$, …, where P_1, P_2, …, and $\neg P_m$, $\neg P_{m+1}$, … are all and only members of S.

Let A be {P_1's obtaining, P_2's obtaining, …, and P_m's not obtaining, P_{m+1}'s not obtaining, …}. We know that if $\neg Q_m$ is a deltification of $\neg P_m$, then Q_m is a deltification of P_m. It follows that B is A's deltification: for any n, B assigns the value of (not) obtaining to Q_n if and only if A assigns the very same value to P_n, where Q_n is a deltification of P_n. Given that Q is P's deltification and that Q's obtaining is determined by B, by (Det-d), we have it that P's obtaining is determined by A. Given that S is A's factualization, it follows that P is grounded in S. Therefore, the principle of grounding descent holds.

(Can P be a member of S? No. If P is a member of S, then P has two deltifications one of which is partially grounded in the other. That cannot happen. For example, [λ(a instantiates the property of being F)] and [λ(the property of a's being F obtains)] are both deltifications of [λFa]. If a is F, then both of them are grounded in the fact [λFa]. But there is no grounding relation between them.

Can S have facts irrelevant to P's obtaining? No. If S has facts irrelevant to P's obtaining, then T must also have facts irrelevant to Q's obtaining. That goes against our supposition that T grounds Q.)

So far so good for the principle of grounding descent. Now return to the complicated case. As I believe, if there are unary determinable properties, then it is hard to reject nullary determinable properties. In the aforementioned case, [λ(a has 8-kilogram-mass)] is such a property. Let me call it "P." Given Rosen's treatment of determinable properties, there is no reason to deny that "for the determinable P to obtain is for some determinate property of P or other to obtain" is a true real definition statement. Naturally, [λ(a is composed of b and c, b has 3-

kilogram-mass, and c has 5-kilogram-mass)] is such a determinate property of P.

Let me call this determinate property "Q." Given the above discussion, we have it

that the fact [λ(Q obtains)] grounds the fact [λ(P obtains)]. By the principle of

grounding descent, Q grounds P. In other words, [λ(a is composed of b and c, b

has 3-kilogram-mass, and c has 5-kilogram-mass)] grounds [λ(a has 8-kilogram-

mass)].

Since I cannot find any other uncovered cases of metaphysical grounding, in

general, we have it that

(G) A set S of obtaining nullary properties grounds an obtaining nullary

property P if and only if

(i) S is the factualization of the assignment A-A`, where the factualization

of A proto-grounds P and the partially opposite assignment A` of A

determines P's not obtaining; or

(ii) S is the factualization of the assignment A∩A`, where the

factualization of A grounds P and the partially opposite assignment A` of A

determines P's obtaining.

Here, the clause (i) is used to derive grounding from proto-grounding, and the

clause (ii) is used to derive a ground without overdetermination.

In (G), S fully grounds P. With the notion of full grounding, we can define

"partial grounding" as follows: if S fully grounds P, then any non-empty subset of

S partially grounds P. Here, the subset can be a proper subset of S, or can be S

itself. Also, let us call a member of S "a grounding fact."

(It should be noted that Fine's (2012) zero-grounded case is plausible only if we understand grounding in terms of ontological dependence. For example, the empty set is derivative, but it depends on nothing. In this sense, the empty set is zero-grounding. However, this understanding of grounding is different from the one I am discussing.)

Chapter 4: The Meta-theory of Metaphysical Grounding

Recall that, in Chapter 3, I raise three concerns. Now we are in a position to remove them. The first concern is about the irreflexivity of the grounding relation. I will soon argue that both full grounding and partial grounding are irreflexive. The first concern is thereby removed.

The second concern is about true operational grounding claims which have no corresponding true factive real definition statements. I assume that all such cases are derivative from the cases in which the operational grounding claim is true and it has corresponding true factive real definition statement. I use the clause (i) of (G) to deal with those having corresponding true factive real definition statements, and then use the clause (ii) of (G) to deal with derivative cases. If all derivative cases are covered by (ii), then the concern is removed.

However, are there any good reasons to believe that true grounding claims having no corresponding true factive real definition statements are all derivative from true grounding claims having corresponding true factive real definition statements? Assuming that we fully describe the world, are there any "brute" facts about grounding in the sense that they do not correspond to any true factive real definition statements and are not derivative from any facts about grounding that correspond to true factive real definition statements?

On my view, that is implausible. If there is a grounding relation between facts, then there must be some building relation(s) B standing between constituents of the facts. (In Bennett's (2017) terminology, the family of building relations is

92

similar to the family of small-g relations. I would like to add property constitution to the family of building relations.) As far as we know, all building relations underwrite true real definition statements. Plausibly, B also underwrites true factive real definition statements. It is rational to believe that the allegedly "brute" fact about grounding is derivative from facts about grounding that correspond to some of these true factive real definition statements.

Finally, (G) is purely metaphysical in nature. The third concern is thereby removed. In this account of metaphysical grounding, I only appeal to the notion of determinant assignment and its factualization (together with a little bit of set theory). As we have previously observed, the notion of determinant assignment can be defined by appealing to principles of determination, and principles of determination are stated in terms of property constitution. It follows that the notion of determinant assignment can be defined in terms of property constitution. Moreover, the notion of factualization can be defined in terms of property constitution and property instantiation. It follows that the notion of metaphysical grounding can be defined in terms of property constitution and property instantiation.

It is true that I leave open the question whether there are any further principles of determination. However, that does not undermine my central claim that the notion of metaphysical grounding can be defined with the notion of determinant assignment and its factualization, which can in turn be defined in terms of property constitution and property instantiation.

I. Metaphysical Grounding Is a Strict Order

Now I want to go over some formal properties of metaphysical grounding. In this section, I will argue that metaphysical grounding is a strict order. More precisely, I will argue that both full grounding and partial grounding are irreflexive, asymmetrical and transitive.

Is metaphysical grounding a strict order? Raven (2012) and Rosen (2010) endorse it. Audi (2012) and Bennett (2017) claim that metaphysical grounding is both irreflexive and asymmetrical. Jenkins (2011) questions the irreflexivity of metaphysical grounding. Schaffer (2012) questions the transitivity of metaphysical grounding. Rodriguez-Pereyra (2015) claims that metaphysical grounding is neither irreflexive, nor asymmetric, nor transitive.

Consider the irreflxivity of partial grounding first. The clause (ii) of the definition (PG) of proto-grounding requires P not to be a member of S. The clause (i) of (G) only removes irrelevant facts, and the clause (ii) of (G) is used to derive a ground without overdetermination. So, P cannot partially ground itself. That also entails that P cannot fully ground itself.

Then consider the asymmetry of partial grounding. As we have previously observed, the clause (ii) of (PG) ensures that all members of S are "simpler" than P. The clause (i) of (G) only removes irrelevant facts, and the clause (ii) of (G) is used to derive a ground without overdetermination. So, P's grounding fact(s) must be "simpler" than P. Hence, partial grounding is asymmetrical. That also entails the asymmetry of full grounding.

Then consider the transitivity of partial grounding. That is,

(Trans-p) If R partially grounds Q, and Q partially grounds P, then R partially

grounds P, where P, Q, and R are obtaining nullary properties.

Given the antecedent, we have it that R together with a set S_1 of facts fully grounds Q, and Q together with a set S_2 of facts fully grounds P. It follows that Q's obtaining is determined by R's obtaining together with an assignment A_1 whose factualization is S_1; and that P's obtaining is determined by Q's obtaining together with an assignment A_2 whose factualization is S_2. Given (Add) and (Trans) of determination, we have it that R's obtaining together with A_1 and A_2 determines P's obtaining. Hence, $R \cup S_1 \cup S_2$ fully grounds P; and R partially grounds P.

(Can P be a member of $R \cup S_1 \cup S_2$? No. By the asymmetry of partial grounding, P cannot be R and P cannot be a member of S_1. And by the irreflexivity of partial grounding, P cannot be a member of S_2.

Can R be irrelevant to P's obtaining? No. If R is irrelevant to P's obtaining, then R must be irrelevant to Q's obtaining. That goes against our supposition that R partially grounds Q.)

The transitivity of full grounding states:

(Trans-f) If S_1 fully grounds S_2, and S_2 fully grounds P, then S_1 fully grounds

P, where P is an obtaining nullary property and S_1 and S_2 are sets of

obtaining nullary properties.

Obviously, (Trans-p) does not entail (Trans-f). By (Trans-p), we can derive that S_1 partially grounds P. However, that does not entail that S_1 fully grounds P.

Here is the argument for the transitivity of full grounding. Given that S_2 fully grounds P, let us suppose that P's obtaining is determined by the assignment A_2 {Q_1's obtaining, Q_2's obtaining, …, and Q_m's not obtaining, Q_{m+1}'s not obtaining, …} and S_2 is A_2's factualization. Then S_2 is {Q_1, Q_2, …, and $\neg Q_m$, $\neg Q_{m+1}$, …}.

Given that S_1 fully grounds S_2, let us suppose that S_2's obtaining, i.e., {Q_1's obtaining, Q_2's obtaining, …, and $\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining}, is determined by the assignment A_1 {R_1's obtaining, R_2's obtaining, …, and R_n's not obtaining, R_{n+1}'s not obtaining, …} and S_1 is A_1's factualization. Then S_1 is {R_1, R_2, …, and $\neg R_n$, $\neg R_{n+1}$, …}.

Given the irreflexivity of partial grounding, S_1 and S_2 have no shared members. That is, {R_1, R_2, …, and $\neg R_n$, $\neg R_{n+1}$, … } and {Q_1, Q_2, …, and $\neg Q_m$, $\neg Q_{m+1}$, …} have no shared members. Hence, A_1 cannot have any of Q_1's obtaining, Q_2's obtaining, … and $\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining, … as its member. Suppose for reduction that A_1 has any of them. Then at least one member of S_1 is Q_1, Q_2, …, or $\neg Q_m$, $\neg Q_{m+1}$, ….

By the same token, A_1 cannot have any of Q_m's not obtaining, Q_{m+1}'s not obtaining, … as its member. Suppose for reduction that R_n's not obtaining is identical with Q_m's not obtaining. Then R_n is just Q_m, and $\neg R_n$ is just $\neg Q_m$. It follows that one member of S_1 is $\neg Q_m$.

We will see that the above two features of A_1 play a significant role in the following argument for transitivity.

If A_1 determines {Q_1's obtaining, Q_2's obtaining, …, and $\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining, …}, does it also determine A_2 {Q_1's obtaining, Q_2's obtaining,

…, and Q_m's not obtaining, Q_{m+1}'s not obtaining, …}? It depends. As we know, $\neg Q_m$'s obtaining does not determine Q_m's not obtaining. So, if A_1 has any of $\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining, …, then A_1 does not determine A_2. But, as I just argued, A_1 does not have any of them.

If so, then A_1 must have a subset to determine {$\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining, …}. The subset can be either {Q_m's not obtaining, Q_{m+1}'s not obtaining, …} or anything that determines it. However, as I just argued, A_1 does not have any of Q_m's not obtaining, Q_{m+1}'s not obtaining, … as its member. Then A_1 must have a subset which determines {Q_m's not obtaining, Q_{m+1}'s not obtaining, …}, and thereby determines {$\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining, …}.

Likewise, given that A_1 determines {Q_1's obtaining, Q_2's obtaining, …, and $\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining, …}, A_1 either has {Q_1's obtaining, Q_2's obtaining, …} as its subset, or has anything that determines it as its subset. As I just argued, A_1 does not have any of Q_1's obtaining, Q_2's obtaining, …. So, A_1 must have a subset which determines {Q_1's obtaining, Q_2's obtaining, …}.

Let us take stock. A_1 has a subset to determine {Q_m's not obtaining, Q_{m+1}'s not obtaining, …} and it also has a subset to determine {Q_1's obtaining, Q_2's obtaining, …}. Then, A_1 must determine A_2, which is the union of them. If so, given that A_2 determines P's obtaining, by (Trans) of determination, we have it that A_1 also determines P's obtaining. Given that S_1 is the factualization of A_1, it follows that S_1 fully grounds P. In other words, full grounding is transitive.

(Can P be a member of S_1? No. If P is a member of S_1, then P partially grounds S_2. Also, we have the supposition that S_2 fully grounds P. That goes against the asymmetry of partial grounding.

Can S_1 has a member irrelevant to P's obtaining? No. If S_1 has a member irrelevant to P's obtaining, then either the member is irrelevant to S_2's obtaining, or it is relevant to S_2's obtaining but S_2 has a member irrelevant to P's obtaining. That goes against our supposition that S_1 fully grounds S_2 and S_2 fully grounds P.

Can A_1 have a member which is irrelevant to the determination of A_2? No. Recall that A_2 is {Q_1's obtaining, Q_2's obtaining, …, and Q_m's not obtaining, Q_{m+1}'s not obtaining, …}. If A_1 has such an irrelevant member, then it is also irrelevant to the determination of {Q_1's obtaining, Q_2's obtaining, …, and $\neg Q_m$'s obtaining, $\neg Q_{m+1}$'s obtaining, …}. That goes against our supposition that A_1 determines S_2's obtaining.)

II. Metaphysical Grounding Is Not Necessary

In this section, I will argue that the entailment principle and the internality principle are false. In other words, metaphysical grounding is not necessary nor internal. But, still, we have good reasons to believe that necessary metaphysical laws exist, and they are non-Humean.

In my terminology, the entailment principle states:

(Entail) If a set S of obtaining nullary properties fully grounds an obtaining

nullary property P, then, necessarily, if all the members of S obtain,

then P obtains.

Fine (2012), Rosen (2010), and Trogdon (2013) endorse the entailment

principle, while Leuenberger (2014) and Skiles (2015) deny it. I will argue that,

given the above account of full grounding, the entailment principle is false.

Metaphysical grounding is not necessary.

Here is the counterexample. Suppose that everything is F. The fact $[\lambda \forall x F x]$ is

fully grounded in the facts $[\lambda F a]$, $[\lambda F b]$, …, where a, b, … are all the objects.

Intuitively, there could have been something distinct from a, b, …. So, there is a

possible world w such that if w were actualized, then there would have been

something distinct from a, b, …. Suppose further that it is not F relative to w,

while a, b, … are still F relative to w. It follows that, if w were actualized, then all

the above facts $[\lambda F a]$, $[\lambda F b]$, … would have still been facts, but the nullary

property $[\lambda \forall x F x]$ would not have obtained.

In my terminology, the internality principle states:

(Inter) If a set S of obtaining nullary properties fully grounds an obtaining

nullary property P, then, necessarily, if all the members of S obtain and

P obtains, then S fully grounds P.

Rosen (2015) takes it as a plausible thesis, while Litland (2015) denies it. I

will argue that the internality principle is also false. Metaphysical grounding is not

internal.

With a little change, the above case can be turned into a counterexample to (Inter). Let us now suppose that everything is F relative to w. So, if w were actualized, then the nullary property [λ∀xFx] would have obtained. However, it is not true that if w were actualized, then the facts [λFa], [λFb], … would have fully grounded the fact [λ∀xFx]. Suppose that there is something that is F but distinct from a, b, … relative to w. Then [λ∀xFx] would have had other grounding facts if w were actualized.

One may respond that if we take the totality fact of a, b, …'s being all the objects as a grounding fact of [λ∀xFx], then the problem can be avoided. I agree with that. However, assuming that the totality fact is understood as a universal fact, this response gives rise to reflexive partial grounding. Consider the universal fact [λ(∀x(if x is an object, then x is a or b or …))]. It is grounded in the facts [λ(a is an object)], [λ(b is an object)], … together with the totality fact of a, b, …'s being all the objects. Given our assumption, the totality fact is just [λ(∀x(if x is an object, then x is a or b or …))]. That goes against the irreflexivity of partial grounding.

One might propose instead that the universal fact [λ∀xFx] is grounded in the facts [λFa], [λFb], … together with the totality meta-fact of [λFa], [λFb], …'s being all the facts about F things (Armstrong, 2004). Again, assuming that the totality meta-fact is understood as a universal fact, then the totality meta-fact is grounded in the fact of [λFa]'s being a fact about F things, the fact of [λFb]'s being a fact about F things, …, together with a further totality meta-fact: they are

all the facts about facts about F things. By the transitivity of full grounding, we have an infinite regress of grounding. It is not clear that we should bite the bullet.

A third route is to deny that the totality fact is a universal fact (Fine, 2012). However, that makes the nature of the totality fact perplexing. In this sense, (Entail) comes with a cost.

The failure of the entailment principle makes us concerned about the legitimacy of appealing to our modal intuitions to argue against grounding claims. However, that should not be a concern. Obviously, all the principles of determination are necessary. If a nullary property P is taken to be constituted in a certain way, then, according to the principles of determination, P's obtaining or not obtaining is supposed to be determined in a certain manner. Now suppose that our modal intuitions tell us that the property's obtaining or not obtaining is not so determined. Then we should think twice whether we get P's constitution right. If in the end, we decide to change our view on P's constitution, then our view on P's metaphysical grounding should be changed accordingly.

The reason why the principles of determination are not subject to the aforementioned objection is that they are formulated in terms of non-rigid "all the specifications of …", which has different extensions relative to different possible worlds. By employing the same technique, we have

(L$_1$) An obtaining universal unary property P is fully grounded in all its specifications.

This principle of grounding is necessary and internal to P. It is because this principle of grounding only depends on how P is constituted and how a property

is constituted is necessary and internal to the property. In contrast, how a property is distributed is, generally speaking, not necessary nor internal. Hence, P's specifications may vary.

Wilsch (2015, 2016) has proposed three constraints for something to be a metaphysical law: the strength-constraint, the generality-constraint, and the modality-constraint. To put it simply, metaphysical laws must be non-probabilistic, general, and necessary. It is obvious that (L_1) satisfies all three constraints. If Wilsch is right, then (L_1) is a metaphysical law.

It should be noted that (L_1) is explained by facts about property constitution, not by this particular obtaining universal unary property's being so grounded, that particular obtaining universal unary property's being so grounded, etc. Hence, this metaphysical law is non-Humean.

There are many other metaphysical laws. To name a few, an obtaining double-negative unary property $\neg\neg P$ is fully grounded in P; an obtaining existential unary property P is fully grounded in one of its obtaining specifications. All these metaphysical laws are non-Humean.

III.   Some Facts About Property Constitution Are Ungrounded

In this section, I will apply my account of metaphysical grounding to the meta-grounding problem and argue that some facts about property constitution are ungrounded.

The meta-grounding problem (Bennett, 2011; Litland, 2017; Rosen, 2010; Sider, 2018) is whether a fact about grounding is further grounded. If facts about grounding are always further grounded, then a variant of Bradley's regress will come back.

As I have claimed, the fact f_1 of a's being F grounds the fact f_2 of a's instantiating the property of being F. It seems that Bradley's regress is resolved. Now, let f_4 be the fact of f_1's grounding f_2. What grounds f_4? Suppose that it is grounded in f_3. Then what grounds the fact of f_3's grounding f_4? … There will be an infinite regress of grounding.

I want to show that some facts about property constitution are ungrounded. Take the conjunctive fact $[\lambda(Fa \text{ and } Gb)]$ for example. We know that it is grounded in its conjuncts, the facts $[\lambda Fa]$ and $[\lambda Gb]$. But what grounds the fact of the conjunctive fact's being grounded in its conjuncts? Given the above discussion, we have it that it is grounded in the fact of $\{[\lambda Fa], [\lambda Gb]\}$'s being the factualization of a determinant assignment of the conjunctive fact. They are in turn grounded in the fact of $[\lambda(Fa \text{ and } Gb)]$'s being the conjunction of $[\lambda Fa]$ and $[\lambda Gb]$, the fact of a's being F and the fact of b's being G.

No doubt, the fact of a's being F and the fact of b's being G may themselves be grounded. A more interesting question is what grounds the fact about the constitution of the conjunctive fact. On my view, either it is ungrounded, or it is grounded in some other facts about property constitution. Perhaps to be a conjunction is to be the result of conjoining. Perhaps the notion of conjoining is a determinate of the determinable property constituting, or it may be a species of

the genus property constituting. It appears that if the fact of [λ(Fa and Gb)]'s being the conjunction of [λFa] and [λGb] is indeed grounded, it must be grounded in other facts about property constitution.

That shows that either some facts about property constitution are fundamental, or the family of facts about property constitution *as a whole* is fundamental. Hence, facts about grounding are either grounded in fundamental facts about property constitution or grounded in the family of facts about property constitution (together with other facts such as the fact of a's being F and the fact of b's being G in the above example).

Admittedly, I assume that some notion(s) in the theory of property constitution are fundamental. A competing proposal is to define notions in the theory of property constitution in terms of determination. For example, to be a conjunctive nullary property is to be the thing whose obtaining or not obtaining is determined in accordance with (Conj).

However, there are a few difficulties with this proposal. First, it is much harder to define the notion of conjunctive property. It appears that we need a notion of determination that applies to all properties, not just nullary properties. Second, it appears that some notions in the theory of property constitution cannot be defined in terms of determination. Predication is a case in point.

As I believe, instead of defining notions in the theory of property constitution in terms of determination, we should define determination in terms of notions in the theory of property constitution.

What I do in Chapter 3 is to define determination in terms of principles of determination, which are stated in terms of property constitution. However, this approach has demerits. One may wonder what unifies all the principles of determination. More importantly, we need an independent account of determination to see that the proposed principles are right principles of determination. This is a difficult question which deserves to be addressed in the future.

At the end of the dissertation, I want to make two final remarks on my account of metaphysical grounding. First, as is shown by the examples in the beginning of Chapter 3, this account of metaphysical grounding is intended to unify all "small-g" relations in Wilson's (2014; 2016) terminology. It also provides a substantial answer to Koslicki's (2015) challenge to the unity hypothesis. Metaphysical grounding is a well-defined notion. We have a good reason to believe that metaphysical grounding is a single relation.

It is true that I do not touch difficult philosophical problems such as what grounds the fact of a state of affairs' being good. However, if there is a true real definition statement "for a state of affairs to be good is …," then my account of metaphysical grounding is readily applicable.

Second, as is shown above, I hold a realist attitude towards metaphysical grounding. (Here, "being real" is understood as being mind-independent.)

On my view, the most appealing anti-realist account of metaphysical grounding is the normativist account. In general, a normativist takes facts about metaphysical grounding to be explained by rules that we should follow. For

example, we are to derive the truth "the water molecule W has a positive pole" from the truth "the molecule composed of two hydrogen atoms H_1 and H_2 and one oxygen atom O being bonded has a positive pole" (in an explanatory sense of derivation).

Of course, a normativist (Thomasson 2007, 2013) can accept that the above rule is partly explained by the fact of W's being composed of H_1, H_2, and O being bonded. We can abstract the fact away and thereby obtain a more general and more fundamental rule: we are to derive the truth "a has a positive pole" from the truth "the F has a positive pole", where "a" is a name of a molecule and "the F" is a description of a's chemical composition. Suppose that we abstract all such facts away. We can call the resulting rules "grounding-generative rules."

One concern about the normativist account is to explain why we are rational to follow such grounding-generative rules. After all, there are competing alternatives to these rules. What makes these rules grounding-generative and all competing alternatives not grounding-generative (in a non-causal sense of "makes")? That is left unexplained in the normativist account.

Works Cited

Anderson, C. A. (2001). A Criterion of Identity for Intensional Entities. In M. Zelëny, & C. A. Anderson (Eds.), *Logic, Meaning, and Computation: Essays in Memory of Alonzo Church* (pp. 305--395). Kluwer Academic Publishers.

Armstrong, D. M. (2004). *Truth and Truthmakers.* Cambridge University Press.

Audi, P. (2012). A Clarification and Defense of the Notion of Grounding. In F. Correia, & B. Schnieder (Eds.), *Metaphysical Grounding: Understanding the Structure of Reality* (pp. 101--121). Cambridge University Press.

Balcerak Jackson, B. (2007). Beyond Logical Form. *Philosophical Studies, 132*, 347--380.

Bealer, G. (1982). *Quality and Concept.* Oxford University Press.

Bealer, G. (1994). Property Theory: The Type-Free Approach V. The Church Approach. *Journal of Philosophical Logic, 23*, 139--171.

Bennett, K. (2011). By Our Bootstraps. *Philosophical Perspectives, 25*, 27--41.

Bennett, K. (2017). *Making Things Up.* Oxford University Press.

Correia, F. (2008). Ontological Dependence. *Philosophy Compass, 3*, 1013--1032.

Correia, F., & Schnieder, B. (2012). Grounding: An Opinionated Introduction. In F. Correia, & B. Schnieder (Eds.), *Metaphysical Grounding: Understanding the Structure of Reality* (pp. 1--36). Cambridge University Press.

Correia, F., & Skiles, A. (2017). Grounding, Essence, and Identity. *Philosophy and Phenomenological Research*, 642--670.

Daly, C. (2012). Scepticism About Grounding. In F. Correia, & B. Schnieder (Eds.), *Metaphysical Grounding: Understanding the Structure of Reality* (pp. 81-100). Cambridge University Press.

Dasgupta, S. (2009). Individuals: An Essay in Revisionary Metaphysics. *Philosophical Studies, 145*, 35--67.

Dorr, C. (2016). To Be F Is To Be G. *Philosophical Perspectives, 30*, 39--134.

Evans, G. (1978). Can There Be Vague Objects? *Analysis, 38*, 208.

Fine, K. (1994a). Essence and Modality. *Philosophical Perspectives, 8*, 1--16.

Fine, K. (1994b). Senses of Essence. In W. Sinnott-Armstrong, D. Raffman, & N. Asher (Eds.), *Modality, Morality and Belief. Essays in Honor of Ruth Barcan Marcus.* Cambridge University Press.

Fine, K. (1995). Ontological Dependence. *Proceedings of the Aristotelian Society, 95*, 269--290.

Fine, K. (2012). Guide to Ground. In F. Correia, & B. Schnieder (Eds.), *Metaphysical Grounding* (pp. 37--80). Cambridge University Press.

Horwich, P. (1998). *Truth.* Clarendon Press.

Inwagen, P. v. (2006). Names for Relations. *Philosophical Perspectives, 20*, 453--477.

Jenkins, C. S. (2011). Is Metaphysical Dependence Irreflexive? *The Monist, 94*, 267--276.

Jubien, M. (2009). *Possibility.* Oxford University Press.

King, J. C. (1998). What is a Philosophical Analysis? *Philosophical Studies, 90*(2), 155-179.

King, J. C. (2016). Philosophical and Conceptual Analysis. In T. S. Herman Cappelen (Ed.), *The Oxford Handbook of Philosophical Methodology* (pp. 249-261). Oxford University Press.

King, J., & Stanley, J. (2005). Semantics, Pragmatics, and the Role of Semantic Content. In Z. Szabó (Ed.), *Semantics Versus Pragmatics* (pp. 111--164). Oxford University Press.

Koslicki, K. (2012). Varieties of Ontological Dependence. In F. Correia, & B. Schnieder (Eds.), *Metaphysical Grounding: Understanding the Structure of Reality* (pp. 186-213). Cambridge University Press.

Koslicki, K. (2015). The Coarse-Grainedness of Grounding. *Oxford Studies in Metaphysics, 9*, 306--344.

Leuenberger, S. (2014). Grounding and Necessity. *Inquiry: An Interdisciplinary Journal of Philosophy, 57*, 151--174.

Litland, J. E. (2015). Grounding, Explanation, and the Limit of Internality. *Philosophical Review, 124*, 481--532.

Litland, J. E. (2017). Grounding Grounding. In K. Bennett , & D. W. Zimmerman (Eds.), *Oxford Studies in Metaphysics* (Vol. 10, pp. 279--315). Oxford University Press.

Merricks, T. (2001). Varieties of Vagueness. *Philosophy and Phenomenological Research, 62*, 145--157.

Rayo, A. (2013). *The Construction of Logical Space.* Oxford University Press.

Rodriguez-Pereyra, G. (2015). Grounding is Not a Strict Order. *Journal of the American Philosophical Association, 1*, 517--534.

Rosen, G. (2010). Metaphysical Dependence: Grounding and Reduction. In B. Hale, & A. Hoffmann (Eds.), *Modality: Metaphysics, Logic, and Epistemology* (pp. 109--36). Oxford University Press.

Rosen, G. (2015). Real Definition. *Analytic Philosophy, 56*, 189--209.

Schaffer, J. (2009). On What Grounds What. In D. Manley, D. J. Chalmers, & R. Wasserman (Eds.), *Metametaphysics: New Essays on the Foundations of Ontology* (pp. 347--383). Oxford University Press.

Schaffer, J. (2012). Grounding, Transitivity, and Contrastivity. In F. Correia, & B. Schnieder (Eds.), *Metaphysical Grounding: Understanding the Structure of Reality* (pp. 122--138). Cambridge University Press.

Schaffer, J. (2016). Grounding in the Image of Causation. *Philosophical Studies, 173*, 49--100.

Sider, T. (2018). Ground Grounded. *Philosophical Studies*, 1--21.

Skiles, A. (2015). Against Grounding Necessitarianism. *Erkenntnis, 80*, 717--751.

Speaks, J. (2011). *Facts, properties, and the Nature of the Proposition.* Retrieved from https://www3.nd.edu/~jspeaks/papers/facts-properties-propositions.pdf

Thomasson, A. L. (2007). Modal Normativism and the Methods of Metaphysics. *Philosophical Topics, 35*, 135--160.

Thomasson, A. L. (2013). Norms and Necessity. *Southern Journal of Philosophy, 51*, 143--160.

Trogdon, K. (2013). Grounding: Necessary or Contingent? *Pacific Philosophical Quarterly, 94*, 465--485.

Wilsch, T. (2015). The Nomological Account of Ground. *Philosophical Studies, 172*, 3293--3312.

Wilsch, T. (2016). The Deductive-Nomological Account of Metaphysical Explanation. *Australasian Journal of Philosophy, 94*, 1--23.

Wilson, J. M. (2014). No Work for a Theory of Grounding. *Inquiry: An Interdisciplinary Journal of Philosophy, 57*, 535--579.

Wilson, J. M. (2016). The Unity and Priority Arguments for Grounding. In K. Aizawa, & C. Gillett (Eds.), *Scientific Composition and Metaphysical Ground* (pp. 171--204). Basinstoke: Palgrave MacMillan.