Why 0-adic Relations Have Truth Conditions: Essence, Ground, and Non-Hylomorphic Russellian Propositions

20 February 2018
Cody Gilmore
gilmore@ucdavis.edu

1. Introduction

I formulate an account, in terms of essence and ground, that explains why atomic Russellian propositions have the truth conditions they do. The key ideas are that (i) atomic propositions are just 0-adic relations,[1] (ii) truth is just the 1-adic version of the *instantiation* (or, as I will say, *holding*) relation (Menzel 1993: 86, note 27), and (iii) atomic propositions have the truth conditions they do for basically the same reasons that partially plugged relations, like *being an x and a y such that Philip gave x to y*, have the holding conditions *they* do.

The account is meant to be mainly of intrinsic interest, but I hope that it goes some distance toward answering an objection to classical theories of propositions put forward by King (2014), who writes that 'since the classical conception of propositions as things that have truth conditions by their very natures and independently of minds and languages is incapable of explaining how or why propositions have truth conditions, it is unacceptable' (2014: 47).[2] Propositions do have their truth conditions 'by their very natures' and 'independently of minds and languages'. But a fact about a given entity can hold by the very nature of that entity without being a fundamental fact.

I argue that this is plausibly the case for atomic Russellian propositions and the facts about their truth conditions. A fact about the truth conditions of such a proposition holds by the very nature of the given proposition but is metaphysically grounded in facts about that proposition's parts and their essences. If my account is correct, then the supposedly intractable problem of explaining why the given propositions have the truth conditions they do reduces to the problem of explaining why relations have the holding essences they do, which few seem to have found worrisome.[3]

A warning. Although I do argue for various components of the theory, the arguments will amount to nothing more than gentle nudges, and they will have almost no force on those who are not already attracted to views in the vicinity of the intended conclusion. I hope the paper does some interesting philosophical work anyway. Most of that work, such as it is, comes in the form of just stating a certain simple-minded theory, which I find plausible without argument. The theory has not, as far as I know, been set out explicitly before.

2. Ground, essence, and Russellian propositions

I will help myself to the notions of constitutive essence (Fine 1995a, b) and metaphysical ground (Rosen 2010; Fine 2012). I assume that if it is essential to a thing α that so-and-so, then it is metaphysically necessary that so-and-so, and the fact that is metaphysically necessary that so-and-so is fully grounded in the fact that is essential to α that so-and-so (Rosen 2010: 119, note 11).[4] More formally, I assume that every instance of the following schema is true:

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[1] This view is discussed by Quine (1960: 165) and endorsed by Bealer (1982), Zalta (1988), Menzel (1993), and van Inwagen (2004).

[2] See Speaks (2014: 147-151) for a related objection.

[3] Thanks to David Sanson for this way of putting it.

[4] I also follow Rosen (2010) in four other ways. (i) My official ideology for ground consists of a primitive predicate '*x* is fully grounded by *yy*', symbolized '$x \leftarrow yy$'. (ii) I take this grounding predicate to express a transitive and asymmetric relation that holds only between facts – specifically, between an individual fact *x*, which gets grounded, and some ('a plurality of') facts *yy*, which collectively do the grounding. I offer a formal statement of the relevant transitivity principle in section 11. (iii) I use square brackets to form names of facts: e.g., 'the fact that grass is green' gets abbreviated as '[grass

The Essence Grounds Necessity Schema

If $\Box_{xx}\varphi$ then $[\Box\varphi] \leftarrow [\Box_{xx}\varphi]$

If it's essential to xx that φ, then the fact that it's necessary that φ is fully grounded in the fact that it's essential to xx that φ.

Assume that it's essential to s that Socrates is a member of s. Then the above schema lets us conclude that the fact that it's necessary that Socrates is a member of s is fully grounded in the fact that it's essential to s that Socrates is a member of s.

Now for a quick sketch of a view about atomic Russellian propositions. Some of it may be dispensable in what follows, but it will probably be helpful to proceed with a specific theory in mind. An atomic Russellian proposition is an abstract (non-spatiotemporal) entity composed of the objects that the proposition is about together with the relation that it predicates of them. For example, the proposition that Philip gave Bucephalus to Alexander – call it *p0* – is composed of these four things: Philip, Bucephalus, Alexander, and the *gave* relation.[5] To say that a thing *x* is composed of things *yy* is to say that each of *yy* is a part of *x* and each part of *x* overlaps (shares a part with) at least one of *yy*. So, on my view, p0 has each of those four things as parts (in the same sense of 'part' as that in which a certain rock is a part of Mt. Etna), and they *exhaust* the p0, in the sense that p0 does not have any additional parts that don't overlap any of those four things.

A Tinkertoy sculpture is composed of some Tinkertoys that are stuck together. It is not composed of those Tinkertoys *and* the relation *being stuck together*. That relation is not a part of the sculpture. Perhaps it is essential to that sculpture that it is composed of things that stand in the *being stuck together* relation; even so, the relation is not a part of the sculpture. Similarly, there may be some relation R that does not overlap the *gave* relation, Philip, Bucephalus, or Alexander but that is somehow involved in the essence of p0; perhaps it is essential to p0 that the *gave* relation bears R to Philip, Bucephalus, and Alexander in that order. Even so, no such relation R is a part of p0, *pace* Caplan, Tillman, and Nutting (this volume). Just as hylomorphism about Tinkertoy sculptures is false (van Inwagen 2014), so is hylomorphism about propositions. That, anyway, is the picture that I will be working with in what follows.

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is green]'. (iv) My official ideology for essence consists of an undefined operator, 'it is essential to *xx* that φ', i.e., '$\Box_{xx}\varphi$', that expresses the notion of constitutive essence (Fine 1995a, b). I assume that constitutive essence is fundamental, rather than being defined, e.g., in terms of consequential essence and ground, as it is in Fine (2012) and Rosen (2015). For reasons to reject such definitions, see Livingstone-Banks (2017) and Nutting, Caplan, and Tillman (2018).

[5] This is a simplification. My official account of the mereological structure of p0 is framed in terms of a four-place, location-relative parthood relation, expressed by '*x* at its location *y* is a part of *z* at its location *w*'. For example, a certain rock, at its spacetime location r_1 (but perhaps not at another of its spacetime locations, r_1*) is a part of a certain volcano, at its spacetime location r_2 (but perhaps not at another of its spacetime locations, r_2*). As this relation applies to propositions, the locations in questions are *slots* in the entities expressed by, e.g., predicates and sentential connectives. Some slots, e.g., those in the meanings of connectives, are *predicative*, and others, e.g., those in the *gave* relation, are *objectual*; no slot is both objectual and predicative. This allows us to say: (i) p0 occupies at least one predicative slot, and for any predicative slot *s* that p0 occupies, there are three different objectual slots s_1, s_2, and s_3, such that s_1 is the first slot in the *gave* relation at *s*, s_2 is the second slot in *gave* at *s*, and s_3 is the third slot in *gave* at *s*, and Philip at s_1 is a part of p0 at *s*, and Bucephalus at s_2 is a part of p0 at *s*, and Alexander at s_3 is a part of p0 at *s*, and *gave* at *s* is a part of p0 at *s*, and for any *x* and *y*, if *x* at *y* is a part of p0 at *s*, then either *x* at *y* overlaps Philip at s_1 or *x* at *y* overlaps Bucephalus at s_2 or *x* at *y* overlaps Alexander at s_3 or *x* at *y* overlaps *gave* at *s*, and (ii) p0 occupies at least one objectual slot, and for any objectual slot *s* that p0 occupies, p0 is *simple* at *s*, i.e., for any *x* and any *y*, if *x* at *y* is a part of p0 at *s*, then *x*=p0 and *y*=*s*. (To say that *x* at *y* overlaps *z* at *w* is to say that for some *u* and *u**, *u* at *u** is a part of *x* at *y* and *u* at *u** is a part of *z* at *w*.) In short, a given atomic proposition is complex at predicative slots and simple at objectual slots; at a given predicative slot, the proposition p0 has, as parts, Philip at the first slot in *gave*, Bucephalus at the second slot in *gave*, Alexander at the third slot in *gave*, and *gave* itself at the predicative slot in question, and no other parts disjoint from all of those. For independent developments of the proposal that parthood is four-place, see Gilmore (2009) and Kleinschmidt (2011), who ends up arguing against the proposal. For the application to propositions, see Gilmore (2014).

3. Truth

Propositions have truth conditions. Let's say that a sentence s *correctly specifies the truth conditions* of a proposition p if and only if (i) s is a true instance of the following schema

TS $\quad \Box($ __ is true if and only if . . .),

and (ii) s results from putting a term that rigidly designates p in the first blank in TS. Let 'Bob' be a rigid, directly referential proper name for the proposition that grass is green. Then both of the following sentences are true and correctly specify Bob's truth conditions:

T1 $\quad \Box$(Bob is true if and only if grass is green)

T2 $\quad \Box$(Bob is true if and only if (grass is green and 2 is prime)).

In addition to truth conditions, propositions have something more fine-grained, which I will call *truth essences*.[6] I will say that a sentence s correctly specifies the truth essence of a proposition p if and only if (i) s is a true instance of the following schema:

ES $\quad \Box$ __ (*** is true if and only if . . .),

and (ii) s results from putting terms that rigidly designate p in the '___' and '***' blanks. For example, it is plausible that E1, the essentialist counterpart of T1, correctly specifies Bob's truth essence:

E1 $\quad \Box_{\text{Bob}}$ (Bob is true if and only if grass is green)

E1 says that it is essential to Bob – it is 'part of what it is to be Bob' – that Bob is true if and only if grass is green. That is plausible.[7] By contrast, the essentialist counterpart of T2 is not plausible:

E2 $\quad \Box_{\text{Bob}}$ (Bob is true if and only if (grass is green and 2 is prime))

E2 says that it is essential to Bob that Bob is true if and only if (grass is green and 2 is prime). Granted, it is metaphysically necessary that Bob is true iff (grass is green and 2 is prime). But it is not essential to Bob – not part of what it is to be Bob – that Bob is true iff (grass is green and 2 is prime).

It is worth noting that we now have the resources to give a perfectly correct, if not very satisfying or informative, explanation of a fact about Bob's truth conditions. The *explanandum* is

f1 $\quad [\Box$(Bob is true if and only if grass is green)].

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[6]This way of putting it, which appears to reify entities called *truth conditions* and *truth essences*, is loose shorthand for talk about instances of TS and ES.

[7] As noted by Pautz (2016: 481). One might grant T1 and grant that it is essential to Bob that greenness is a part or constituent of Bob while denying E1, on the grounds that truth and truth conditions are not sufficiently internal to Bob. (Thanks to Jack Spencer for raising this worry.) One option would be to retreat to the view, call it E1*, that $\Box_{\text{Bob, truth}}$ (Bob is true iff grass is green), i.e., that it is essential to Bob and truth collectively that Bob is true iff grass is green. But in my view no such retreat is needed. I find E1 at least as plausible as the claim that it is essential to {Socrates} individually, not merely to {Socrates} and membership collectively, that Socrates is a member of {Socrates}. A parallel worry applies to all the other essentialist claims I make throughout the paper, including, e.g., the claim that it is essential to g3, the relation expressed by 'gave', that it holds of *x*, *y*, and *z* in that order iff *x* gave *y* to *z*. In each case I offer a parallel reply. However, even if I were to retreat to E1* and its ilk, I could still do most of what I want to do in the paper. As I explain later, what I call the Explanatory Argument will need to be modified slightly.

As a reminder, square brackets are used so that an expression like ‘[snow is white]’ abbreviates ‘the fact that snow is white’. It is syntactically a term, not a sentence. f1, which is a ‘merely modal’ fact about Bob, is fully grounded in

f2 $\quad [\Box_{\text{Bob}}(\text{Bob is true if and only if grass is green})]$,

which is an essence fact about Bob. That f1 is fully grounded in f2, i.e., that f1 ← f2, follows from E1 together with the relevant instance of the Essence Grounds Necessity Schema. Why is it metaphysically necessary that Bob is true iff grass is green? Because it is essential to Bob that Bob is true iff grass is green.

Before we get to the more interesting part of the account, in which we specify the grounds of facts like f2, I want to pause to consolidate and generalize on the points we have made so far. First, I want to try to capture a generalization in the vicinity of E1. E1 is about Bob in particular. It says that it is essential to Bob that Bob is true iff grass is green. But presumably something similar holds for every proposition. Can this thought be made explicit and fully general? If one allows quantification into sentence position, one can write:

TEQ $\quad \forall x \text{ if } x \text{ is a proposition then } (\exists S\ x{=}\langle S\rangle\ \&\ \Box_x(x \text{ is true iff } S))$,

where angle brackets are used to form singular terms that denote propositions. (‘<S>’ abbreviates ‘the proposition that S’.) Without quantification into sentence position, one might need to rest content with the claim that every instance of the following schema is true:

TES $\quad \forall x \text{ if } x{=}\langle\varphi\rangle \text{ then } \Box_x(x \text{ is true iff } \varphi)$,

where an instance of TES is formed by substituting some English sentence in for ‘φ’. This is less than fully general, since that it says nothing about propositions that are not expressed by any English sentence.

Second, I want to try to capture a generalization in the vicinity of the claim that f1 ← f2. Allowing ourselves quantification into sentence position, we could write

EGQ $\quad \forall x \text{ if } x \text{ is a proposition then } \exists S\ (x{=}\langle S\rangle\ \&\ [\Box(x \text{ is true iff } S)] \leftarrow [\Box_x\ (x \text{ is true iff } S)])$.[8]

A corresponding schema might be:

EGS $\quad \forall \mathrm{x} \text{ if } x{=}\langle\varphi\rangle \text{ then } [\Box(x \text{ is true iff } \varphi)] \leftarrow [\Box_x(x \text{ is true iff } \varphi)]$.

EGS follows from TES together with the Essence Grounds Necessity Schema.

4. Holding

Just as propositions have truth conditions, properties and relations have instantiation conditions – or, as I will say, *holding* conditions. Let’s say that a sentence s correctly specifies the holding conditions of a property p if and only if (i) s is a true instance of

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[8] However, the desire to avoid quantifying into sentence position is one main motivation for expressing full ground with a predicate, ‘←’, rather than a sentential connective, ‘because’. If we allow ourselves quantification into sentence position, it seems that can capture the idea behind EGQ more directly as

EGQ* $\quad \forall x(\text{if } x \text{ is a proposition then: } \exists S(x{=}\langle S\rangle\ \&\ ((\Box(\mathrm{x} \text{ is true iff } S)) \text{ because } (\Box_x(x \text{ is true iff } S)))))$,

which avoids the detour through facts.

HCS $\Box\forall x($ __ holds of x if and only if . . .),

and (ii) s results from putting a term that rigidly designates p in the first blank in HCS. For example, let 'Mary' be a rigid, directly referential name for the property *being human*. Then both of the following sentences are true and correctly specify Mary's holding conditions:

HC1 $\Box\forall x$ (Mary holds of x if and only if x is human)

HC2 $\Box\forall x$ (Mary holds of x if and only if (x is human and 2 is prime))

And as with propositions, properties and relations also have something more fine-grained, which I will call *holding essences*. I will say that a sentence s correctly specifies the holding essence of a property p if and only if: (i) s is a true instance of

HES $\Box_{\_\_}\forall x$ (*** holds of x if and only if . . .),

and (ii) s results from putting terms that rigidly designate p in the '__' and '***' blanks. It is plausible that HE1, the essentialist counterpart of HC1, correctly specifies the holding essence of Mary:

HE1 $\Box_{\text{Mary}}\forall x$ (Mary holds of x if and only if x is human)

HE1 says that it is essential to Mary that Mary holds of an entity if and only if that entity is human. This is plausible (as noted by Gilmore 2013: 209-210 and Pautz 2016: 481).[9] By contrast, the essentialist counterpart of HC2 is not plausible:

HE2 $\Box_{\text{Mary}}\forall x$(Mary holds of x if and only if (x is human and 2 is prime)).

It is metaphysically necessary, but not essential to Mary, that Mary holds of a given entity if and only if: that entity is human and 2 is prime.

It is tempting, but incorrect, to read HE1 as saying that it is essential to Mary that Mary holds of an entity if and only if Mary holds of that entity.[10] My view is that 'Obama is human' and 'Mary holds of Obama' express different propositions, on the grounds that (i) holding is a part of the latter proposition but not of the former, (ii) Mary (*being human*) is a predicative part of the former but not of the latter, and (iii) Mary is an objectual part of the latter but not of the former.[11] For parallel reasons, I say that '$\forall x$ (Mary holds of x if and only if x is human)' and '$\forall x$ (Mary holds of x if and only if Mary holds of x)' express different propositions. HE1 is true if and only if the former proposition belongs to Mary's constitutive essence. (I assume that a

[9] Several nearby claims are also plausible: (a) if Bob is true, then the fact that Bob is true is grounded in the fact that grass is green; (b) if Mary holds of a thing, then the fact that Mary holds of it is grounded in the fact that it is human; (c) it is essential to Bob that if Bob is true, then the fact that Bob is true is grounded in the fact that grass is green; (d) it is essential to Mary that if Mary holds of a thing, then the fact that Mary holds of it is grounded in the fact that it is human. For a defense of claims like (b), and further elaboration of analogies between properties, relations, and propositions, see Dixon (2017). Those who accept both HE1 and (d) will be committed to some redundancy in Mary's constitutive essence. (Thanks to Jeff Russell for this point.) Pautz (2016) also mentions claims like (c) and (d).

[10] Analogously, it would be wrong to read E1 as saying either (i) that it is essential to Bob that Bob is true if and only if Bob is true or (ii) that it is essential to Bob that Bob is true if and only if *greenness* holds of grass. ('Grass is green' and 'greenness holds of grass' express different propositions.)

[11] To say that x is a predicative (alternatively: objectual) part of y is to say that for some slots s and s^*, s is a predicative (alternatively: objectual) slot and x at s is a part of y at s^*. See note 5.

thing's constitutive essence is a set of propositions.) HE1 is silent as to whether the latter proposition belongs to Mary's constitutive essence.

To extend the parallel between propositions and properties a bit farther, we can point out that, just as f1 is fully grounded in f2, HE1 and the relevant instance of the Essence Grounds Necessity Schema together entail that

f3 $[\Box\forall x(\text{Mary holds of } x \text{ if and only if } x \text{ is human})]$

is fully grounded in

f4 $[\Box_{\text{Mary}}\forall x(\text{Mary holds of } x \text{ if and only if } x \text{ is human})]$.

Why is it metaphysically necessary that Mary holds of all and only those things that are human? Because it is essential to Mary that Mary holds of all and only those things that are human. Presumably something similar is true of all properties. As in the case of propositions, however, it is not clear how to capture this generalization explicitly.

What goes for properties goes for relations. Better, what goes for 1-adic relations also goes for relations whose adicity is 2 or greater. They all have holding conditions, which are relatively coarse-grained, and holding essences, which are more fine-grained. I leave it to the reader to write out some examples.

To flesh out the analogies more explicitly and generally, I will introduce a series of primitive predicates of the form 'HOLD^{n}', where n (for now greater than or equal to 2) specifies the adicity of the predicate. Thus we have 'HOLD^2', which is a 2-adic predicate, 'HOLD^3', which is a 3-adic predicate, and so on. Informally, '$\text{HOLD}^2(x, y)$' means that x is instantiated by (holds of) y; '$\text{HOLD}^3(x, y, z)$' means that x is instantiated by y and z in that order; '$\text{HOLD}^4(x, y, z, w)$' means that x is instantiated by y, z, and w in that order; and so on. It might be that each of these predicates expresses a different holding relation, each with a fixed adicity. Alternatively, it might be that each of these predicates expresses the same variably polyadic relation or the same dyadic relation with a second slot that is plural and order-sensitive. (Thanks to David Liebesman for pointing out this third option.) I take no stand.

I will also use a variable-binding lambda operator, '$\Lambda x_1 \ldots x_{\text{n}}$' that abbreviates 'being an $x_1 \ldots$ and an x_{n} such that'. This operator attaches to a well-formed formula and yields an expression that is syntactically a term, not a predicate (Fine 2012: 67-71). (Menzel (1993) develops a language in which these expressions can occupy either term position or predicate position.) For example, '$\Lambda xyz\ x$ gave y to z' is a singular term that denotes a certain 3-adic relation: *being an x, a y, and a z such that x gave y to z.*

Equipped with these expressions, we can generalize. Properties and relations – hereafter, just 'relations' – have holding essences, which can be specified schematically as follows:

GES $\forall u$ if $u{=}\Lambda x_1 \ldots x_{\text{n}}\,(\varphi\, x_1 \ldots x_{\text{n}})$ then

$$\Box_u\forall x_1 \ldots \forall x_{\text{n}}(\text{HOLD}^{\text{n+1}}(u, x_1, \ldots, x_{\text{n}}) \text{ if and only if } \varphi\, x_1 \ldots x_{\text{n}})$$

In words: if u is the n-adic relation *being an $x_1 \ldots$ and an x_n such that so-and-so,* then it is essential to u that, for any x_1, . . ., and any x_{n}, u holds of x_1, . . ., and x_{n} in that order if and only if so-and-so. Together, GES and the Essence Grounds Necessity Schema entail

GGS $\forall u$ if $u = \Lambda x_1 \ldots x_{\text{n}}(\varphi\, x_1 \ldots x_{\text{n}})$ then

$$[\Box\forall x_1 \ldots \forall x_{\text{n}}(\text{HOLD}^{\text{n+1}}(u, x_1, \ldots, x_{\text{n}}) \text{ if and only if } \varphi\, x_1 \ldots x_{\text{n}})] \leftarrow$$

$$[\Box_u\forall x_1 \ldots \forall x_{\text{n}}\ (\text{HOLD}^{\text{n+1}}(u, x_1, \ldots, x_{\text{n}}) \text{ if and only if } \varphi\, x_1 \ldots x_{\text{n}})]$$

In words: if *u* is the n-adic relation *being an x_1 . . . and an x_n such that so-and-so*, then the fact that it is metaphysically necessary that, for any x_1, . . ., and any x_n, *u* holds of x_1, . . ., and x_n in that order if and only if so-and-so is fully grounded by the fact that it is essential to *u* that, for any x_1, . . ., and any x_n, *u* holds of x_1, . . ., and x_n in that order if and only if so-and-so.

5. Plugging

An n-adic relation, I assume, has exactly n slots in it, and when n is greater than or equal to 1, these slots are ordered: there is a unique 1st slot in it, . . ., and a unique nth slot in it.[12] *Being an x and a y such that x loves y* is a 2-adic relation, so it has exactly two slots in it, a first slot and a second slot.[13] Further, I assume that the slots in a relation can be plugged by things to form a 'partially plugged' relation of a lesser adicity than the original relation. The first slot in the 2-adic relation *being an x and a y such that x loves y* can be plugged by Barack to form the 1-adic relation *being a y such that Barack loves y*. Similarly, the second slot in the original 2-adic relation can be plugged with Barack to form the 1-adic relation *being an x such that x loves Barack*.

I will focus on a certain 3-adic plugging relation, which I will express with the predicate, 'PLUG1'. (I adapt the terminology of Zalta (1988), who uses '$plug_1$' as a function symbol.) Roughly, 'PLUG1(*x*, *y*, *z*)' means that plugging the first slot in the relation *x* with *y* results in *z*, in which case *x* is an n-adic relation, *z* is an (n-1)-adic relation, n is greater than or equal to 1, and *y* might be anything whatsoever. A bit less roughly, 'PLUG1(*x*, *y*, *z*)' means that there is a slot *s*, which is the first slot in *x*, and *y* occupies *s*, and *y*, at *s*, combines with *x* to compose *z*.[14] Here is an example:

If g3=Λ*xyz*(*x* gave *y* to *z*) and g2=Λ*yz*(Philip gave *y* to *z*), then PLUG1(g3, Philip, g2).

This says that if g3 is the relation *being an x, a y, and a z such that x gave y to z*, and if g2 is the relation *being a y and a z such that the Philip gave y to z*, then plugging the first slot in g3 with Philip results in g2. See Figure 1.

[12] See Gilmore (2013) for a case for the existence of slots and for references to many other realists about slots. That slots are ordered within a relation is presupposed by Zalta (1988), Menzel (1993: 69), Swoyer (1998: 307), and Gilmore (2014: 191).

[13] Officially, if a relation R is n-adic, then R occupies at least one predicative slot, and for any predicative slot *s* that R occupies, R has exactly n slots at *s*, where this allows that (i) R occupies objectual slots but R has no slots in it *at* those objectual slots and (ii) each of the n slots that R has at *s* is numerically distinct from any of the n slots that R has at any of the other predicative slots that R occupies. By analogy: a lump of dough might have a hole in it at t_1 when it is donut-shaped, have no holes at t_2 when it is ball-shaped, and have a numerically distinct hole at t_3 when it is donut-shaped again. See note 5 and Gilmore (2014).

[14] Officially, to say that PLUG1(*x*, *y*, *z*) is to say that *x* occupies at least one predicative slot, and for any predicative slot *s* that *x* occupies, there is an *s** such that: (i) *s** is the 1st slot in *x* at *s*, (ii) *y* at *s** is a part of *z* at *s*, (iii) *x* at *s* is a part of *z* at *s*, and (iv) for any *w* and *w**, if *w* at *w** is a part of *z* at *s*, then *w* at *w** overlaps *y* at *s** or *w* at *w** overlaps *x* at *s*. See note 5.

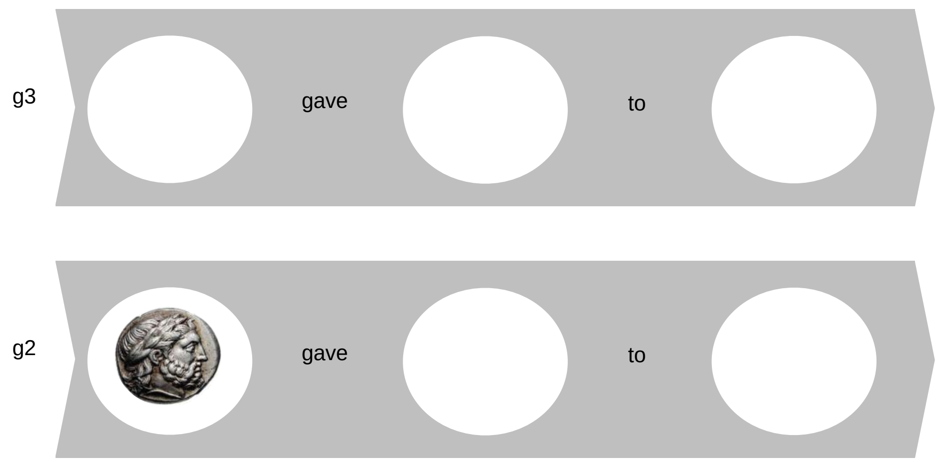

Figure 1

6. Grounding the facts about the holding essences of partially plugged relations

Partially plugged relations have holding conditions and holding essences. Let g3 be Λxyz(x gave y to z), and let g2 be Λyz(Philip gave y to z). Now consider the following fact about the holding essence of g2:

f5 $[\Box_{g2}\forall x_1\forall x_2(\mathrm{HOLD}^3(g2, x_1, x_2) \text{ if and only if Philip gave } x_1 \text{ to } x_2)]$

What, if anything, grounds f5? Why does g2 have *that* holding essence? Two facts seem relevant. The first is the fact that the 3-adic, fully unsaturated relation g3 has the holding essence that *it* does. This fact is

f6 $[\Box_{g3}\forall x_1\forall x_2\forall x_3(\mathrm{HOLD}^4(g3, x_1, x_2, x_3) \text{ if and only if } x_1 \text{ gave } x_2 \text{ to } x_3)]$.

The second is the fact that g2 is related to g3 in a certain way: g2 is what results from plugging Philip into the first slot in g3. Plugging the first slot in g3 with Philip results in g2. This second fact is

f7 [PLUG1(g3, Philip, g2)]

These two facts, f6 and f7, seem to be enough to fully ground f5. In symbols:

GP1 f5 $\leftarrow$ f6, f7.

The partially plugged relation g2 has the holding essence it has because: (i) it results from plugging the first slot of g3 with Philip, and (ii) the 'simpler', completely unsaturated relation g3 has the holding essence *it* has. Consider another example. Let g1 be the 1-adic relation Λx(Philip gave Bucephalus to x). See Figure 2.

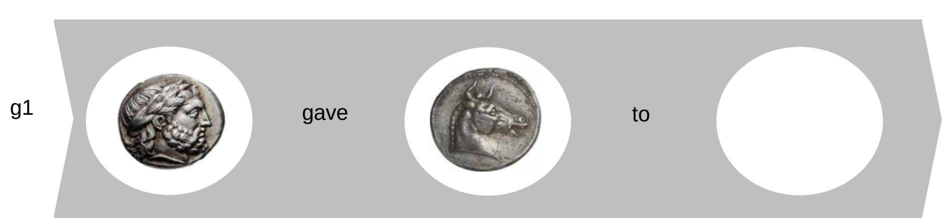

Figure 2

Here is a fact about the holding essence of g1:

f8 [$\Box_{g1}\forall x_1$(HOLD^2(g1, x_1) if and only if Philip gave Bucephalus to x_1)]

What grounds f8? It is plausible that f8 is grounded in f5, together with

f9 [PLUG1(g2, Bucephalus, g1)].

That is, it is plausible that

GP2 f8 ← f5, f9.

The bottom two arrows in Figure 4 represent GP1 and GP2.

7. 0-adic relations exist

My claims so far have been about relations whose adicity is 1 or greater. I will now use these claims as premises in a series of inductive arguments for conclusions about 0-adic relations. The first argument is meant to motivate the view that there are 0-adic relations.

The Inductive Existence Argument

1. (a) Λ*xyz*(*x* gave *y* to *z*) exists and is a 3-adic relation; (b) Philip exists and is a material object[15]; and (c) there is a *w* such that (i) *w*=Λ*yz*(Philip gave *y* to *z*), (ii) *w* is a 2-adic relation, and (iii) PLUG1(Λ*xyz*(*x* gave *y* to *z*), Philip, *w*). *Fa & Ga*

2. (a) Λ*yz*(Philip gave *y* to *z*) exists and is a 2-adic relation; (b) Bucephalus exists and is a material object; and (c) there is a *w* such that (i) *w*=Λ*z*(Philip gave Bucephalus to *z*), (ii) w is a 1-adic relation, and (iii) PLUG1(Λ*yz*(Philip gave *y* to *z*), Bucephalus, *w*). *Fb & Gb*

3. (a) Λ*z*(Philip gave Bucephalus to *z*) exists and is a 1-adic relation; (b) Alexander exists and is a material object. *Fc*

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4. So, (c) there is a *w* such that (i) *w*=Λ(Philip gave Bucephalus to Alexander), (ii) *w* is a 0-adic relation, and (iii) PLUG1(Λ*z*(Philip gave Bucephalus to *z*), Alexander, *w*). *Gc*

In a nutshell, the argument is this. The relation g3 has three slots. You can plug the first slot in g3 to get a new relation, g2, which has only two slots; you can plug the first slot in g2 to get a new relation, g1, which has only one slot; so, by enumerative induction, you should be able to plug the first and only slot in g1 to get yet another relation, which will have no slots. Let *g0* be a rigid, directly referential name for this 0-adic relation, Λ(Philip gave Bucephalus to Alexander).[16] See Figure 3.

[15] In light of the Russell-Myhill paradox (on which see Appendix B of Russell (1903), Myhill (1958)), I hesitate to say that for just *any* n-adic (n>0) relation R and for just *any entity x* whatsoever, there will always be some entity *y* that results from plugging the first slot in R with *x*. But given that g3 is an ordinary relation and given that Philip is a material object, it is hard to see why there wouldn't be an entity that results from plugging the Philip into the first slot in g3. I hope that my account harmonizes with some natural solution to the Russell-Myhill paradox and other paradoxes about propositions (on which see Deutsch (this volume)), but I cannot do justice to this issue here.

[16] It is tempting to translate the lambda expression 'Λ(Philip gave Bucephalus to Alexander)' into philosopher's English as 'being such that Philip gave Bucephalus to Alexander'. (Thanks to Noël Saenz and Eileen Nutting for pointing this out.) But I can't allow that translation, since the latter expression denotes a 1-adic relation, *being an x such that Philip gave Bucephalus to Alexander* (=Λ*x*(Philip gave Bucephalus to Alexander)). My reply is just to deny that I am under any obligation to find a translation of the given lambda expression into philosopher's English.

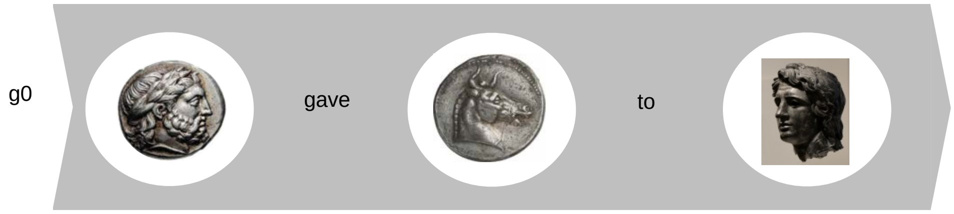

Figure 3

If the argument seems weak in that it is an induction from only two cases, we can revise it by using a different example. Instead of starting with a 3-adic relation, we can start with a googolplex-adic relation, and gradually work our way toward relations of lesser adicity by plugging slots, one by one. This will increase our sample size but leave the argument otherwise unchanged. If the revised argument is too weak, it will not be due to an overly small sample size.

8. Facts about the holding essences of 0-adic relations are grounded in the familiar way

Now for a second inductive argument. To state it, I will need a 1-adic holding predicate, 'HOLD^1', in addition to those already on the table. I assume that if one grasps the meanings of our older 'HOLD^n' predicates, and if one extrapolates in the natural way from those cases, one can grasp the meaning of 'HOLD^1' as well. Just as '$\text{HOLD}^3(x, y, z)$' means that x holds of y and z in that order, and '$\text{HOLD}^2(x, y)$' means that x holds of y, '$\text{HOLD}^1(x)$' means that x just plain *holds*, i.e., that x holds *simpliciter*. 'HOLD^1' is to 'HOLD^2' what 'HOLD^2' is to 'HOLD^3' and what 'HOLD^3' is to 'HOLD^4'. And so on.

With all this in hand, we are in a position to set out a second inductive argument. It is meant to motivate the view that the 0-adic relation g0 has a certain holding essence, and the fact that it has this holding essence is grounded in the fact that g1 has the holding essence it has, together with the fact that plugging the first slot in g1 with Alexander results in g0.

The Inductive Grounding Argument

1. $\text{g3}=\Lambda x_1x_2x_3(x_1 \text{ gave } x_2 \text{ to } x_3)$ & $\Box_{\text{g3}}\forall x_1\forall x_2\forall x_3(\text{HOLD}^4(\text{g3}, x_1, x_2, x_3) \text{ if and only if } x_1 \text{ gave } x_2 \text{ to } x_3)$ & PLUG1(g3, Philip, g2) & $\text{g2}=\Lambda x_1x_2(\text{Philip gave } x_1 \text{ to } x_2)$ &

   $\Box_{\text{g2}}\forall x_1\forall x_2(\text{HOLD}^3(\text{g2}, x_1, x_2) \text{ if and only if Philip gave } x_1 \text{ to } x_2)$ &

   $[\Box_{\text{g2}}\forall x_1\forall x_2(\text{HOLD}^3(\text{g2}, x_1, x_2) \text{ if and only if Philip gave } x_1 \text{ to } x_2)] \leftarrow$

   $[\Box_{\text{g3}}\forall x_1\forall x_2\forall x_3(\text{HOLD}^4(\text{g3}, x_1, x_2, x_3) \text{ if and only if } x_1 \text{ gave } x_2 \text{ to } x_3)]$,

   [PLUG1(g3, Philip, g2)] *Fa & Ga*

2. $\text{g2}=\Lambda x_1x_2(\text{Philip gave } x_1 \text{ to } x_2)$ & $\Box_{\text{g2}}\forall x_1\forall x_2(\text{HOLD}^3(\text{g2}, x_1, x_2) \text{ if and only if Philip gave } x_1 \text{ to } x_2)$ & PLUG1(g2, Bucephalus, g1) and $\text{g1}=\Lambda x_1(\text{Philip gave Bucephalus to } x_1)$ & $\Box_{\text{g1}}\forall \text{x}_1(\text{HOLD}^2(\text{g1}, x_1) \text{ if and only if Philip gave Bucephalus to } x_1)$ & $[\Box_{\text{g1}}\forall x_1(\text{HOLD}^2(\text{g1}, x_1) \text{ if and only if Philip gave Bucephalus to } x_1)] \leftarrow$

   $[\Box_{\text{g2}}\forall x_1\forall x_2(\text{HOLD}^3(\text{g2}, x_1, x_2) \text{ if and only if Philip gave } x_1 \text{ to } x_2)]$,

[PLUG1(g2, Bucephalus, g1)] *Fb & Gb*

3. g1=Λx_1(Philip gave Bucephalus to x_1) & $\Box_{g1}\forall x_1$($HOLD^2$(g1, x_1) if and only if Philip gave Bucephlus to x_1) & PLUG1(g1, Alexander, g0) and g0=Λ(Philip gave Bucephalus to Alexander) *Fc*

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4. So, $\Box_{g0}\forall x_1$($HOLD^1$(g0) if and only if Philip gave Bucephalus to Alexander) &

[$\Box_{g0}\forall x_1$($HOLD^1$(g0) if and only if Philip gave Bucephalus to Alexander)] ←

[$\Box_{g1}\forall x_1$($HOLD^2$(g1, x_1) if and only if Philip gave Bucephalus to x_1)],

[PLUG1(g1, Alexander, g0)] *Gc*

In a nutshell: (i) g2 results from plugging the first slot in g3 with Philip, g2 has a certain holding essence, and g2 has this holding essence because it results from plugging the first slot in g3 with Philip and g3 has the holding essence *it* has; (ii) g1 results from plugging the first slot in g2 with Bucephalus, g1 has a certain holding essence, and g1 has this holding essence because it results from plugging the first lot in g2 with Bucephalus and g2 has the holding essence *it* has; (iii) g0 results from plugging the first slot in g1 with Alexander; so, by induction, g0 should have a certain holding essence, and it should have that holding essence because it results from plugging the first slot in g1 with Alexander and g1 has the holding essence it has. (As with the previous argument, the sample size can be increased by choosing a different example.)

If we let f10 be [$\Box_{g0}$($HOLD^1$(g0) if and only if Philip gave Bucephalus to Alexander)] and f11 be [PLUG1(g1, Alexander, g0)], then the conclusion of the Inductive Grounding Argument entails that

GP3 f10 ← f11, f8,

which can be added to GP1 and GP2. This is a convenient place to try to capture a generalization underlying GP1, GP2, and GP3. In schematic form:

The Hold-Plug Schema

$\forall u \forall u^* \forall y$ if (($u=\Lambda x_1 \ldots x_n(\varphi\, x_1, \ldots, x_n)$ & PLUG1(u, y, u^*)) then

[$\Box_{u^*}\forall x_1 \ldots \forall x_{n-1}(HOLD^n(u^*, x_1, \ldots, x_{n-1})$ if and only if $\varphi\, y, x_1, \ldots, x_{n-1})$] ←

[$\Box_u \forall x_1 \ldots \forall x_n(HOLD^{n+1}(u, x_1, \ldots, x_n)$ if and only if $\varphi\, x_1, \ldots, x_n)$], [PLUG1($u, y, u^*$)]

where what goes in for ‘n’ must be a term for a number greater than or equal to 1.

In words, the Hold-Plug Schema says that if u is the relation *being some* x_1 *. . . and some* x_n *(for n>0) such that* $\varphi\, x_1, \ldots, x_n$ and if plugging the first slot in u with y results in u^*, then

the fact that it’s essential to u^* that it holds of $x_1, \ldots, x_{n-1}$ in that order if and only if $\varphi\, y, x_1, \ldots, x_{n-1}$

is fully grounded in these two facts, collectively: (i) the fact that it’s essential to u that it holds of $x_1, \ldots, x_n$ in that order if and only if $\varphi\, x_1, \ldots, x_n$, and (ii) the fact that plugging the first slot in u with y results in u^*. In short, if u has an adicity of 1 or greater, and if plugging the first slot in u with y results in u^*, then the fact that u^* has the holding essence that it has is fully grounded in the fact that u has the holding essence that *it* has, together with the fact that plugging the first slot in u with y results in u^*.

9. 0-adic relations are propositions

So far I have argued that a certain 0-adic relation exists (Inductive Existence Argument) and that a certain fact about its holding essence is grounded in the same way as are the facts about the holding essences of relations of greater adicity (Inductive Grounding Argument).

Now I will argue that the given 0-adic relation, Λ(Philip gave Bucephalus to Alexander), is a proposition. It is <Philip gave Bucephalus to Alexander>. Some philosophers (Bealer (1982), Zalta (1988), Menzel (1993), van Inwagen (2004)) already accept the conclusion. I find it plausible on its face. But for those who are on the fence, here is an argument (adapted with slight modifications from Dixon and Gilmore (2016), where it is called the *plugging argument*).

Sentences express propositions relative to contexts. *Mutatis mutandis* for predicates and relations. If we abbreviate ‘expresses, relative the present context’ as just ‘expresses’, then we can argue as follows.

The Inductive Expressing Argument

1. ‘_____ gave ********** to . . . .’ expresses Λxyz(x gave y to z), which is a 3-adic relation.
2. ‘Philip gave ********** to . . . .’ expresses Λyz(Philip gave y to z), which is a 2-adic relation.
3. ‘Philip gave Bucephalus to . . . .’ expresses Λz(Philip gave Bucephalus to z), which is a 1-adic relation.

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4. So, ‘Philip gave Bucephalus to Alexander’ expresses Λ(Philip gave Bucephalus to Alexander), which is a 0-adic relation.
5. But ‘Philip gave Bucephalus to Alexander’ expresses <Philip gave Bucephalus to Alexander>, which is a proposition.
6. ‘Philip gave Bucephalus to Alexander’ expresses at most one thing.

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7. So, Λ(Philip gave Bucephalus to Alexander)=<Philip gave Bucephalus to Alexander>.

It follows from 4, 5, and 7 that at least some 0-adic relations are propositions. Considerations of uniformity then generate pressure toward the view that all 0-adic relations are propositions.

10. Holding[1] is truth

Let us stipulate that *p0* is a rigid, directly referential proper name for <Philip gave Bucephalus to Alexander>. If what I have said so far is correct, then we can draw two additional conclusions about p0 and g0. First, since g0 has a certain holding essence and the facts about its holding essence are grounded in certain other facts, and since p0 is identical to g0, it follows that p0 has that same holding essence and that the facts about its holding essence are grounded in those same other facts. Second, since p0 has a certain *truth* essence, and since p0 just is g0, it follows that g0 has that same truth essence.

But it does not follow that the facts about the truth essence of p0 just are the facts about the holding essence of g0. In particular, it does not follow that

f12 [$\Box_{p0}$(TRUE(p0) if and only if Philip gave Bucephalus to Alexander)]

is identical to

f10 [$\Box_{g0}$(HOLD^1(g0) if and only if Philip gave Bucephalus to Alexander)]

Nothing that I have said so far guarantees that f12=f10. But I want to argue that these facts really are identical, and hence that the grounds of f12 are the grounds of f10.

I am not going to appeal to any principle that supplies informative 'identity conditions' for facts in general. What I will appeal to instead is a more specific, and I hope more secure, claim about f12 and f10 in particular:

ID if 'g0' and 'p0' are directly referential names, then f10=f12 if and only if: (i) 'g0' and 'p0' refer to the same thing and (ii) 'HOLD^1' and 'TRUE' express the same thing.

We know that 'g0' and 'p0' are directly referential names, and we have argued that they do refer to the same thing. All that remains is to argue that 'HOLD^1' and 'TRUE' express the same thing. Some find this claim independently plausible. Menzel, e.g., writes that 'the 1-place exemplification predicate 'Δ^1', of course, is the truth predicate' (1993: 86, note 27). I agree with Menzel. But, for doubters, I offer two arguments.

The first is an inference to the best explanation of certain equivalences that hold between truth and holding^1.

The Explanatory Argument

1. Truth and holding^1 are necessarily equivalent: $\Box\forall x$(HOLD^1(x) if and only if TRUE(x)).

2. Necessarily, everything that has either a truth essence or a holding^1 essence has both a truth essence and a holding^1 essence, and these essences mirror each other precisely, in the following sense: every instance of schema M is true.

M $\Box\forall x$($\Box_x$(TRUE(x) if and only if φ) if and only if $\Box_x$(HOLD^1(x) if and only if φ))[17]

3. 1 and 2 are explained by the hypothesis that truth, which is expressed by 'TRUE', just is holding^1, which is expressed by 'HOLD^1'.

4. No other hypothesis explains 1 and 2 as well.

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5. Truth, which is expressed by 'TRUE', just is holding^1, which is expressed by 'HOLD^1'.

I assume that this needs no further comment.

A second argument for basically the same conclusion rests on some observations about three families of predicates: the 'holds of' family, the 'is instantiated by' family, and the 'is true of' family. The first observation is that 'x holds of y' says the same thing as 'x is instantiated by y', and 'x holds of y and z in that order' says the same thing as 'x is instantiated by y and z in that order', and so on. A second observation is that 'x instantiated by y' says the same thing as 'x is true of y', and 'x is instantiated by y and z in that order' says the same thing as 'x is true of y and z in that order', and so on. It follows that 'x holds of y' says the same thing as 'x is true of y', and 'x holds of y and z in that order' says the same thing as 'x is true of y and z in that order', and so on. This makes it plausible, if wasn't already, that 'x holds' says the same thing as 'x is true', and that 'HOLD^1' expresses the same thing as 'TRUE'. Call this the *True-of Argument*. I conclude that these two

[17] In note 6, I mentioned some weaker variants of the essentialist claims made in this paper. Those who prefer the weaker variants will want to replace M with M*: $\Box\forall x$($\Box_{x,\text{ truth}}$(TRUE(x) if and only if φ) if and only if $\Box_{x,\text{ holding}^1}$(HOLD^1($x$) if and only if φ)).

predicates express the same relation. Together with ID and with our results about 'g0' and 'p0', this conclusion entails that f10=f12.

11. The full picture

The proposition that Philip gave Bucephalus to Alexander is such that, as a matter of metaphysical necessity, it is true if and only if Philip gave Bucephalus to Alexander. That fact about p0, viz.,

f13 [□(TRUE(p0) if and only if Philip gave Bucephalus to Alexander)]

is fully grounded in a fact about the truth essence p0, namely, f12 above. And f12=f10, which is a fact about the holding essence of a certain 0-adic relation. So the grounds of f12 are those of f10. This gives us the grounding structure depicted in Figure 4:

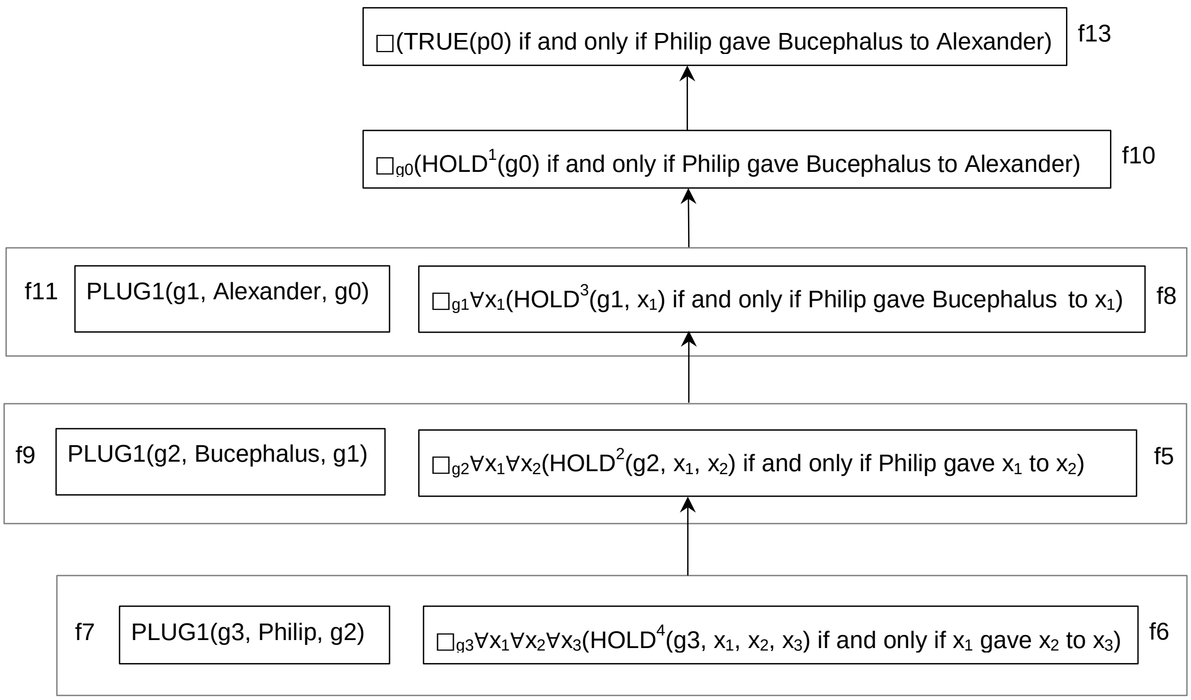

Figure 4

I want to draw one further conclusion from the claims represented in the diagram. Repeated application of the transitivity of grounding[18] to the structure above yields the result that

GP4 f13 ← f11, f9, f7, f6

In other words, f13, the 'canonical' fact about the truth conditions of p0, is fully grounded in three plugging facts together with a fact about the holding essence of the fully unsaturated relation g3. It is plausible that a

[18] $\forall x\forall yy\forall zz\forall ww$ if ($x \leftarrow yy$ & z is one of yy & $z \leftarrow ww$) then $\exists uu\forall u$((u is one of uu iff u is one of ww or (u is one of yy & u is not identical to z)) and $x \leftarrow uu$).

parallel grounding explanation can be given of the canonical fact about the truth conditions of any atomic proposition.[19]

13. Conclusion

I have given an account of what grounds the facts about the truth conditions of atomic Russellian propositions. Those facts are grounded by facts about the truth *essences* of the given propositions. And those latter facts are, in turn, grounded by facts about how the propositions (0-adic relations) are built up by plugging objects into slots in non-0-adic relations, together with facts about the holding essences of the relevant non-0-adic relations.[20] As to the facts for which I have not specified any ground — e.g., f11, f9, f7, f6 — I do not claim that those facts are fundamental. My view is that the 'plugging' facts, f11, f9, and f7, are not fundamental, but rather are grounded in mereological facts, in a way that is constrained by my mereological definition of the *plug1* relation and my account of the parts of propositions. On the other hand, the most basic holding essence fact, f6, is plausibly fundamental, at least if the *gave* relation is simple and has no real definition (on which see Rosen (2015)). Lastly: I hope that my account can be extended in a natural way to non-atomic propositions, but that's a big topic, and I can't do it justice here.[21]

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[19] If there are simple 0-adic relations that do not result from plugging a slot in any 1-adic relation, then the parallel explanation in such cases ends with the fact about the holding essence of the given 0-adic relation. I am not aware of any clear examples of such relations, but inductive arguments much like the ones I give in this paper might generate some reason to think they exist. Thanks to Beau Mount and David Chalmers for pressing this point.

[20] Three final comments on the account. First, the decision to frame the account in terms of 'PLUG1' was arbitrary. One could instead invoke 'PLUG-final(*x*, *y*, *z*),' which means that plugging the final slot in *x* with *y* results in *z*. Casting the account in terms of 'PLUG-final' would single out different but parallel *explantia* facts for the *explandum* fact in question. Both collections *explanantia* – the those isolated by the 'PLUG1' account, and those that would be isolated by the 'PLUG-final' account – fully ground the *explanandum* fact. Thus that fact is overdetermined. But this is no worse than the overdetermination of [grass is green or snow is white], which is fully grounded by [grass is green] and also by [snow is white]. Second, those who are friends of modality but skeptics about Finean essence might still find something of value here. If they replace each essence fact in Figure 4 with the corresponding merely modal fact, the resulting grounding claims (with the exception of the claim represented by the uppermost arrow) might be plausible to them. Third, those who are friends of non-causal explanation broadly understood but skeptics about metaphysical grounding in particular might also find something of value here. If they replace each grounding arrow in Figure 4 (or the merely modal, 'de-essentialized' counterpart of that diagram) with a wavy arrow that represents the appropriate kind of non-causal explanation, the resulting claims might seem plausible to them.

[21] This paper was presented at the Workshop on Philosophical Mereology at Corpus Christi College, Oxford, on 10 April 2014, at the 5th Workshop on Philosophical Logic, hosted by the Buenos Aires Logic Group, on 22 November 2016, at the Inland Northwest Philosophy Conference, on 14 March 2017, and at the University of Kansas on 8 September 2017. Thanks to members of those audiences and especially Ben Caplan, David Chalmers, Aaron Cotnoir, Paul Hovda, Scott Jenkins, Brian Kierland, Dan López de Sa, Beau Mount, Eileen Nutting, Alex Radulescu, Noël Saenz, David Sanson, and Jack Spencer. Very special thanks to Scotty Dixon, David Liebesman, and Joshua Spencer.

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