

# How to build a thought

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## Abstract

We uncover a surprising discovery about the basis of thoughts. We begin by giving some plausible axioms about thoughts and their grounds. We then deduce a theorem, which has dramatic ramifications for the basis of all thoughts. The theorem implies that thoughts cannot come deterministically from any purely “thoughtless” states. We expect this result to be *too* dramatic for many philosophers. Hence, we proceed to investigate the prospect of giving up the axioms. We show that each axiom’s negation itself has dramatic consequences that should be of interest to philosophers of mind. Our proof of the theorem provides a new guiderail for thinking about the nature and origin of thoughts.

## KEYWORDS

aboutness, consciousness, fundamental mentality, grounding, philosophy of mind, thoughts

## 1 | INTRODUCTION

You have thoughts. *How?* What is the basis of a thought? This question takes us to the foundation of all minds.

Let us begin by considering a standard framework for thinking about the basis of thoughts. This framework looks like a construction zone. In this zone are the building blocks for marvelous things, including your thoughts. The construction materials are nonmental bits of reality that can *ground* (fix, determine, or subvene) thoughts.<sup>1</sup> We call this thought-making framework “the grounding framework.” According to the grounding framework, thoughts have their ultimate basis in thoughtlessness. Nonthoughts make thoughts.

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Here is a different framework. Nonthoughts do not make thoughts. In a certain “folk” paradigm, the idea that nonthoughts make thoughts is a strange idea, like the idea that this article has its basis in chaos. Perhaps instead thoughts are first-movers—the ultimate architects. On this framework, even though nonmental things can affect or influence thoughts, the nonmental does not fully ground thoughts.

We will leave open all options at the outset. Maybe thoughts *are* among the basic building materials in the construction zone. Maybe not. Our purpose here is to provide a tool for a fresh inquiry.

The tool we shall bring forth is a proof of a theorem. We aim to inspire new thinking about the basis of thoughts by laying out a proof of this conditional: *if* certain axioms we present are true, *then* the link between thoughts and their nonmental basis is merely contingent; in other words, nonmental items (states or events) do not necessitate any thoughts. This conditional is a guiderail for developing theories about the nature of thoughts and their grounds.

To be clear, our purpose is not to endorse the truth of the antecedent. While we do find the antecedent independently plausible, others could find in the proof a reason to reject the antecedent. The value of the proof, in any case, is that it provides a platform for thinking about thoughts in two ways: either by (i) developing a grounding framework with *other* axioms and teasing out *their* consequences, or (ii) reframing our understanding of the construction zone in which thoughts can arise.

Before we proceed, we wish to draw attention to the significance of having a formal proof in place. In the early stages of developing our argument, several philosophers commented that the conditional—the deduction from axioms to theorem—seemed so surprising that they did not think it *could* be established. For this reason, we develop a precise, formal demonstration. This demonstration provides clear and unforeseen constraints for theorizing about thoughts. It gives our feet secure steps onto new ground.

## 2 | ESTABLISHING THE GUIDERAIL

Thoughts have contents: they are about things. Your thought that the present article is intriguing, for example, has the content *that the present article is intriguing*. We will show that certain principles about the contents of thoughts imply something about the basis of thoughts.

A few preliminaries set the stage. First, we use plural quantifiers “ $\forall xx$ ” and “ $\exists xx$ ” that bind plural variables (taking as values one or many items). Second, we will speak of *classes* without commitment to the existence of classes. Our talk of classes is translatable into talk of pluralities. Third, we will speak of *types* of logically possible thoughts—“thoughts” for short—in variable domain semantics.<sup>2</sup> We speak of types, rather than tokens, because we are interested in the relationship between logically possible types of thoughts and logically possible types of grounds: for example, if particles of a certain type entered a certain arrangement, would a certain type of thought thereby be instantiated? We will speak, then, of types *obtaining* (being instantiated). For ease of presentation, we will also talk about types of grounds.<sup>3</sup>

Next, some definitions. Let  $G$  be the class of types of nonmental grounds of mental types. Let  $Ob(x) = “x$  obtains.” Let  $Gr(g, t) = “Ob(g) \ \& \ Ob(t) \ \& \ g$  grounds  $t.”$  And, let  $E(g, t) = “g$  entails  $t” = “\Box (Ob(g) \supset Ob(t)).”$

We give two modal axioms to characterize (necessitating and full) *grounding*:

Axiom N (Necessitation):  $\forall g \ \forall t \ \Box ((\Diamond Gr(g, t)) \supset E(g, t)).$

Axiom ES (Essentialism):  $\forall t (\Diamond (Ob(t) \ \& \ \sim \exists g Gr(g, t)) \supset \Box \sim \exists g Gr(g, t)).$

Axiom N records the principle that grounds entail (necessitate) that which they ground, while ES says that whatever can be ungrounded is essentially ungrounded (equivalently: necessarily, whatever is grounded cannot be ungrounded).<sup>4</sup> We recognize that there are other (nonnecessitating) notions of grounding, and we will explore the implication of these notions in the next section. For now, we aim to expose a result that governs this particular necessitating conception of grounding.<sup>5</sup>

Another disclaimer: we make no assumptions about what sort of states may be a nonmental ground of a thought. Grounds may include functional states, physical states together with laws, haecceitous states, or any mereological sum of nonmental states.

Next, we give axioms about the *contents* of thoughts. Start with a definition: let “Th(y, xx)” read “y is a thought that at least one of the xx exists.” We call types of thoughts that take the form of y “existence-thoughts.” We focus our argument on existence-thoughts for illustration (and definiteness), while leaving open other ways one might generalize the argument.<sup>6</sup> So, let T be the class of existence-thoughts.

The content axioms:

Axiom EX (Existence):  $\forall gg \in P(G), \exists t(\text{Th}(t, gg))$ , where  $P(G)$  is the class of all subclasses of G.

Axiom D (Distinction):  $\forall gg_1, gg_2 \in P(G), \exists t_1 \exists t_2 [\text{Th}(t_1, gg_1) \ \& \ \text{Th}(t_2, gg_2) \ \& \ t_1 = t_2] \supset gg_1 = gg_2$ .

Axiom I (Independence):  $\forall t \in T, \Diamond [\text{Ob}(t) \ \& \ \sim(\exists t_2 \in T, t_2 \neq t \ \& \ \text{Ob}(t_2))]$ .

Here are translations. Axiom EX is about scope: a thought can be about anything, including any class of grounds.<sup>7</sup> Axiom D adds that thoughts about *different* grounds are *different* thoughts. (This axiom is about types of thoughts; D allows that different people can have different tokens of the same existence-thought.) Axiom I is about independence: every existence-thought can—as a matter of logical possibility—obtain independently of any other existence-thoughts. For example, a thought of the form, <some of the things, A and B, exist> can obtain without a thought of the form <some of the things, C and D, exist>. In general, it is logically possible for any existence-thought to obtain independently of any other existence-thought.

Let us have a closer look at Axiom I. Existence-thoughts have a certain form—i.e., a thought *that at least one of the xx exist*. The form of a thought distinguishes one thought from another. For example, the thought that at least one of the things A and B exists is not the same as the thought that A in particular exists. Axiom I entails that these different thoughts can obtain independently of each other.

One might wonder whether existence-thoughts that overlap in contents can in fact exist independently of each other. To draw out the concern, consider the pair of thoughts:

- i. the thought that one of the things, A and B, exist
- ii. the thought that A exists.

On first blush, one might think (ii) is not independent of (i), for the content of (ii) logically entails the content of (i). This concern brings to light an important distinction between the logical independence of the contents and the existential independence of the thoughts. The proposition that A *exists* logically entails the proposition that *one of the things, A and B, exists*. In other words, the contents of (i) and (ii) are not logically independent. It does not follow, however, that someone can only have the latter thought if someone has the former thought. Someone could obviously *think* that A exists without also thinking anything at all about B. Similarly, someone could think that one of the things, A and B, exists without also thinking that A in particular exists.

Time for the implications. From the above axioms, we will deduce the following theorem about a thought's grounds:

Thoughts Ungrounded:  $\sim \forall t \in T, \exists g \in G \diamond \text{Gr}(g, t)$ .

In English: it is not the case that every existence-thought has a possible nonmental ground.<sup>8</sup>

This result is far from a trivial or easy-to-see consequence of the axioms; it takes a number of steps to deduce the theorem. Therefore, we will offer a detailed deduction (which we take to be the most significant discovery of this article).

Before we give the formal deduction, here is a quick and informal summary. First, by the content axioms, there are at least as many elements of  $T$  as there are elements of  $P(G)$ , since there is at least one (logically possible) existence-thought per group of (logically possible) grounds. Then, by Cantor's theorem, there are strictly *more* elements of  $P(G)$  than elements of  $G$ . It follows that the elements of  $T$  outnumber the elements of  $G$ —i.e., there are more logically possible types of thoughts than logically possible types of grounds for thoughts. Then, by the grounding axioms and the axioms of independence and distinction, there are too many members of  $T$  for each to enjoy its own unique necessitating ground. The result is that some mental types hang free from any nonmental ground.

Now for the details. We assume Cantor's theorem (expressed in terms of plurals),<sup>9</sup> modal system  $S5$ , and inference rules of classical logic. Occurrences of  $g$  and  $t$  pick out elements of  $G$  and  $T$ , respectively.

The deduction:

**Lemma 1** *There is an injective function,  $f: P(G) \rightarrow T$ .*

Proof:

1.  $\forall gg \in P(G), \exists t(\text{Th}(t, gg))$ . (Axiom EX)
2.  $\therefore \exists f P(G) \rightarrow T = (\text{the } t)(\text{Th}(t, gg))$ .<sup>10</sup>
3.  $\forall gg_1, gg_2 \in P(G), \exists t_1 \exists t_2 [\text{Th}(t_1, gg_1) \ \& \ \text{Th}(t_2, gg_2) \ \& \ t_1 = t_2] \supset gg_1 = gg_2$ . (Axiom D)
4.  $\therefore \forall gg_1, gg_2 \in P(G), f(gg_1) = f(gg_2) \supset gg_1 = gg_2$ .
5.  $\therefore f$  is an injective function  $P(G) \rightarrow T$ .

**Lemma 2** *There is no injective function,  $f: P(G) \rightarrow G$ .*<sup>11</sup>

$\therefore$  Counting Theorem: there is no injective function,  $f: T \rightarrow G$ .

Proof (from lemmas):

6. Reductio assumption: there is an injective function  $f_1: T \rightarrow G$ .
7. There is an injective function,  $f_2: P(G) \rightarrow T$ . (Lemma 1)
8. Define  $h(gg): P(G) \rightarrow G = f_1(f_2(gg))$ .
9.  $\therefore \forall gg_1, gg_2 \in P(G), h(gg_1) = h(gg_2) \supset gg_1 = gg_2$ .
10.  $\therefore h$  is an injective function  $P(G) \rightarrow G$ . (contra Lemma 2)

**Lemma 3**  $\forall t \exists g \diamond \text{Gr}(g, t) \supset$  *there is an injective function  $f: T \rightarrow G$ .*

Proof:

11. Assume  $\forall t \exists g \diamond \text{Gr}(g, t)$ .

12.  $\therefore \forall t \Diamond \exists g \text{Gr}(g, t)$ .<sup>12</sup>
13.  $\forall t \Diamond (\text{Ob}(t) \ \& \ \sim \exists g \text{Gr}(g, t)) \supset \Box \sim \exists g \text{Gr}(g, t)$ . (Axiom ES)
14.  $\therefore \forall t \Box [\text{Ob}(t) \supset \exists g \text{Gr}(g, t)]$ .
15.  $\forall t \Diamond [\text{Ob}(t) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$  (Axiom I)
16.  $\therefore \forall t \Diamond \exists g [\text{Gr}(g, t) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$ .<sup>13</sup>
17.  $\therefore \forall t \exists g \Diamond [\text{Gr}(g, t) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$ .
18.  $\therefore \forall t \exists g \text{E}(g, t) \ \& \ \sim \exists t_2 (t_2 \neq t \ \& \ \text{E}(g, t_2))$ .

Proof of (18) from (17):

- a. Assume (17):  $\forall t \exists g \Diamond [\text{Gr}(g, t) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$ .
- b.  $\therefore \forall t \exists g \Diamond [\text{Gr}(g, t) \ \& \ \text{Ob}(g) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$ . (Def. of “Gr”)
- c.  $\therefore \forall t \exists g \Diamond [\text{E}(g, t) \ \& \ \text{Ob}(g) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$ . (Axiom N)
- d.  $\therefore \forall t \exists g \Diamond \text{E}(g, t) \ \& \ \Diamond [\text{Ob}(g) \ \& \ \text{E}(g, t) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$ . (Axiom K of S5)
- e.  $\therefore \forall t \exists g \text{E}(g, t) \ \& \ \Diamond [\text{Ob}(g) \ \& \ \text{E}(g, t) \ \& \ \sim (\exists t_2 t_2 \neq t \ \& \ \text{Ob}(t_2))]$ . (S5)
- f.  $\therefore \forall t \exists g \text{E}(g, t) \ \& \ \Diamond (\sim \exists t_2 t_2 \neq t \ \& \ \text{E}(g, t_2))$ . (Def. of “E”)
- g.  $\therefore \forall t \exists g \text{E}(g, t) \ \& \ \forall t_2 \Box (t_2 \neq t \supset \sim \text{E}(g, t_2))$ .<sup>14</sup>
- h.  $\therefore \forall t \exists g \text{E}(g, t) \ \& \ \forall t_2 (\Box t_2 \neq t \supset \Box \sim \text{E}(g, t_2))$ . (Axiom K of S5)
- i.  $\therefore \forall t \exists g \text{E}(g, t) \ \& \ \forall t_2 (t_2 \neq t \supset \Box \sim \text{E}(g, t_2))$ . (Necessity of distinctness)
- j.  $\therefore$  (18):  $\forall t \exists g \text{E}(g, t) \ \& \ \sim \exists t_2 (t_2 \neq t \ \& \ \text{E}(g, t_2))$ .
19.  $\therefore \exists f(t): T \rightarrow G = (\text{the } g) \text{E}(g, t) \ \& \ \sim \exists t_2 (t_2 \neq t \ \& \ \text{E}(g, t_2))$ .<sup>15</sup>
20.  $\therefore \forall t_1, t_2 f(t_1) = f(t_2) \supset t_1 = t_2$ .
21.  $\therefore f$  is an injective function  $T \rightarrow G$ .<sup>16</sup>

$\therefore$  Thoughts Ungrounded:  $\sim \forall t \exists g \Diamond \text{Gr}(g, t)$ . (Counting Theorem + Lemma 3)

As you might expect, we can obtain a more general result about *all* existence-thoughts if existence-thoughts are *uniform* with respect to groundability. Consider the following axiom of uniformity:

Uniformity (U):  $\forall t_1, t_2 \in T, \sim \exists g \in G \Diamond \text{Gr}(g, t_1) \supset \sim \exists g \in G (\Diamond \text{Gr}(g, t_2))$ .

From U we deduce that no possible existence-thought has a possible nonmental ground:

Universal Ungrounded:  $\sim \exists t \in T, \exists g \in G (\Diamond \text{Gr}(g, t))$ .

We might generalize further still: insofar as (i) the only relevant differences here are differences in content, and (ii) differences in content do not make a difference with respect to groundability, it follows that nonmental things cannot ground any possible thought. Hence, either our thoughts lack nonmental, necessitating-grounds, or we lack thoughts.

### 3 | CONSEQUENCES

We have established a guiderail, which we call “Contents to Grounds”: if the content and grounding axioms are true, then no existence-thought has a nonmental ground. Let us weigh the significance of this discovery further by exploring some of its consequences.

Our package of axioms implies something interesting about you. Your thought *that some of the brains exist* (henceforth, “Brain Thought”) is an existence-thought. From Universal Ungrounded, it follows that you have a thought without any possible (nonmental) ground. This result clearly bears on leading views in the philosophy of mind. Physicalism, for instance, is sometimes defined in terms of grounding:

Grounding Physicalism: For any person S and any thought T such that S is thinking T, there is some physical state P such that P grounds the fact that S is thinking T.<sup>17</sup>

So, according to Grounding Physicalism, Brain Thought is grounded in some physical state. Yet, Universal Ungrounded tells us that Brain Thought is not grounded in any *nonmental* state. The result is that any grounds of Brain Thought are themselves mental. Thus, the mental floats *independently and autonomously* of nonmental elements of reality.

Still, Universal Ungrounded leaves open a broadly physicalist view. In particular, one could suppose that human persons are exhaustively decomposable into nonmental, physical parts, *even if* those parts do not deterministically ground every mental state.<sup>18</sup> Perhaps, even, grounding can go the other way, from the “top-down,” as they say. Particles in your brain can move at the command of your thoughts, even while those thoughts are themselves composed of nothing but those (nonmental) particles. This view denies that (states of) *parts* always ground (states of) the *whole* they compose; grounding can proceed from the whole down to the parts.

This “top-down” solution invites a question about the origin of thoughts. How could a system of particles produce a thought without *grounding* or *necessitating* the thought it produces? Whatever the answer, Contents to Grounds constrains our options, and the significant of our discovery is in seeing this constraint.

Let us try an alternative response. We could view Contents to Grounds as a new argument in support of dropping one or both of the grounding axioms. Although the grounding axioms are negotiable, they arguably capture at least one important understanding of grounding.<sup>19</sup> So having an argument against this conception is noteworthy in its own right.

Moreover, even without the grounding axioms, we have not removed the result that the link between thoughts and their grounds is *contingent*. Suppose we give up N—that grounds *necessitate* that which they ground. Then we expose a new puzzle. Our original puzzle concerns the origin of thoughts: how can thoughts arise from nonthoughts? Grounding theorists give us an answer and a label—“grounding.” Still, if the link between a ground *g* and a thought *t* is merely *contingent* (i.e., *g* does not necessitate *t*), one may wonder what explains the consistency of the connection between *g* and *t*. Is this link a brute, unexplained (*thought-like!*) law, or does it have a deeper explanation? To be clear, contingency is not the only source of puzzlement; one could still wonder how or why a *necessary* link obtains. Nevertheless, contingency may add some puzzlement by removing a certain type of explanation. If the link were instead necessary, then we could say (at least) this much: the link obtains, rather than not, because it *cannot not*. That explanation is not available if the link is merely contingent. In any case, discovering that the link between thoughts and their grounds is merely contingent would be significant in its own right.

Maybe we could deny the other grounding axiom, ES, instead. Suppose ES is false. Then a thought *can* be ungrounded. But if thoughts can be ungrounded but never *are*, then it is puzzling why they never are. Moreover, if we kick away the grounding axioms, our guiderail still leads to the striking result that Grounding Physicalism is at most *contingently* true. In other words, if you want to build a thought, nothing you can do to various nonthinking construction materials will guarantee success—because the link between nonthoughts and thoughts is contingent.

What happens if we give up one or more of the *content* axioms? This move, too, has significant consequences. Suppose we reject axiom EX—that for any possible grounds, there can be a

thought about their existence. Then, contra EX, there can be some nonmental grounds that *cannot* be thought about. In other words, certain nonmental things, but not others, could be the objects of thought. Although paradoxical cases arise with respect to thoughts about *themselves*, the scope of EX includes only nonthoughts. What then could explain the cut-off between the thinkable things and the unthinkable?

The challenge is in seeing how any constraint on what is thinkable could be nonarbitrary. Consider that we have a procedure for coherently defining distinct thoughts in terms of any grounds: (i) first, represent each ground with a phenomenal map (like a visual field); and (ii) second, for any group of phenomenal maps, package them into a conceptual bundle with an existence-thought operator, such as “at least one of the things in \_\_\_ exist.”<sup>20</sup> Why should some of these thoughts be logically possible, but not others? All seem equally coherent.<sup>21</sup>

Suppose instead we decline the axiom of independence or the uniformity of groundability. Then mere differences in content make a difference with respect to independence or groundability. This result would also be significant news. For our part, it seems obvious that a categorical difference with respect to independence or groundability cannot turn on mere differences in content. In any case, if they *can*, then we have the puzzle of explaining how, why, and under what conditions.

Consider, too, that the puzzles resulting from leaving aside the content axioms are akin to the original puzzle about the origin of thoughts and consciousness in general. Part of the puzzle of consciousness (i.e., the hard problem of consciousness) is that it is hard to see how any mere differences in arrangements of materials could account for a *categorical* shift from nonconscious to conscious, from third person features to irreducibly first-person features. One solution is to include first-person building blocks in our construction zone. But if we do not like that solution and instead give up the content axioms, then we have a *new* puzzle: how can a mere difference in particles result in a categorical shift with respect to whether those particles could be the objects of a thought? Are some possible particles simply unthinkable by any logically possible mind? Why would that be? This question points to another hard problem, which we call “the hard problem of content.” This problem is new.

Here is the upshot. We have discovered a new guiderail for thinking about thoughts. The guiderail takes us to three paths. First, we could follow the grounding and content axioms to discover a construction zone with basic mental materials—ungrounded thoughts. Second, we could depart from the grounding axioms and find a surprising contingency between thoughts and nonthoughts. Third, we could depart from the content axioms to discover surprising restrictions on the contents of thoughts. Those paths are open. Yet, we can now close any path that combines our axioms with a strictly bottom-up picture of reality, for if our axioms characterize thoughts, then mindless matter cannot make every element of every mind. Whatever path we take, we now have a new guiderail for advancing our thinking about thoughts.

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## ENDNOTES

<sup>1</sup> Grounding theorists disagree whether it is objects (broadly construed) or facts that ground or are grounded. We sometimes put things in terms of the objectual theory (and thus talk about whether or how *a certain thought* is grounded). There are also questions about the general relationship between grounds of facts vs. the existential dependence of objects (cf. Schnieder, 2020). For our purposes, we leave open these general questions. One may read our talk of grounds in terms of grounds of facts (e.g., the fact that a certain type of



- thought is instantiated) or in terms of grounds of the instantiation of types of thoughts. On grounding in general, see, inter alia, Audi (2012), Bailey (2011), Fine (2012a, 2012b), Rettler (2017), Rosen (2010), Schaffer (2009), Trogdon (2013a), and Wilson (2014).
- <sup>2</sup> We could alternatively express our argument in fixed-domain semantics, where quantification is over possible thoughts. Many translations are possible, and we need not commit to the ontology of any particular system.
- <sup>3</sup> While we quantify over types of grounds, we may translate our talk of types into talk of tokens. For example, “g grounds t” = “necessarily, every token of g grounds a token of t.” Note that we may also talk of *haecceitous* types if we want to talk about grounding that is essentially unique to a given token. Thus, while our argument is in terms of types, it also has implications with respect to grounding tokens.
- <sup>4</sup> Cf. Fine (2012a), Rosen (2010), and Trogdon (2013b).
- <sup>5</sup> See Skiles (2015) for arguments against axiom N; we say more about the prospects for rejecting N below.
- <sup>6</sup> We could just as well give the argument in terms of thoughts of this form: “y is a thought that at least one of the xx is very silly.” It is an open question whether one might run this style of argument on other (intensional) items, like propositions or states of affairs. In that case, we may have an argument for the contingency of these other items (or of their link to more fundamental items) similar to one given in Yu (2018). For sake of modesty and focus, we set aside the question of how far one might plausibly generalize the type of argument we give. Thanks to an anonymous referee for drawing attention to this avenue for further investigation.
- <sup>7</sup> For modesty, we narrow the scope to the class of *nonmental* grounds. Adding mental grounds to the scope of our content axioms generates technicalities involving self-inclusion. For if existence-thoughts can themselves be grounds (e.g., *thinking that blue cheese exists* grounds *thinking that cheese exists*), and if the scope of EX includes these existence-thoughts, then an existence-thought that features the existence of *all* mental grounds will explicitly include itself. We think this self-inclusion is impossible (cf. Yu, 2018). Thus, we restrict the scope to nonmental grounds.
- <sup>8</sup> For ease of presentation, we treat a full ground as an individual, even if the ground consists of many individuals that jointly are a full ground.
- <sup>9</sup> Cantor’s theorem states that the *subsets* of any set outnumber its individual *members*. More precisely, for any set, S, there is no mapping from members of S to S, such that (i) each member of S is mapped to at most one subset of S, and (ii) for every subset S, there is a member of S that is mapped to it. The plural form replaces talk of sets and subsets with talk of plurals and subplurals, respectively. The plural version of the theorem is then established by a plural version of Cantor’s diagonal argument, where the Axiom of Separation is replaced by an axiom schema about plurals.
- <sup>10</sup> For ease of presentation, we refer to *the* thought that satisfies “Th(t, gg).” If there is more than one such thought, just select one of them. We only need at least one to deduce Lemma 1—i.e., that there is at least one thought for each plurality of grounds.
- <sup>11</sup> This follows from Cantor’s theorem expressed in terms of pluralities: for any class (plurality), S, there is no mapping from S to P(S), such that (i) each member of S is mapped to at most one subclass of S, and (ii) for every subclass of S, there is a member of S that is mapped to it.
- <sup>12</sup> This inference is valid in fixed domain semantics. It is also valid in variable domain semantics if types (of logically possible grounds and thoughts) are necessarily existent (i.e., constant elements in every domain).
- <sup>13</sup> See Footnote 12.
- <sup>14</sup> See Footnote 12.
- <sup>15</sup> We can assume for sake of argument that there is at most one ground that satisfies the formula, for if f is injective if there is one such ground, then f is *ipso facto* injective if there is more than one.
- <sup>16</sup> Many thanks to Robert Koons and two anonymous referees for a painstaking review of this proof.
- <sup>17</sup> See Dasgupta (2014) for exploration and defense of the slightly less general thesis according to which the fact that subject S’s brain is in physical state P grounds the fact that S is conscious.
- <sup>18</sup> Leuenberger (2014) argues for nonnecessitating grounds by taking seriously the intuition that the link between the mental and the physical is contingent. Our argument has a similar result: the link between the



mental and nonmental is contingent. This argument assumes that grounds are necessitating. But if grounds are *not* necessitating, as Leuenberger suggests, then the path to a contingent link is all the wider. We say more about the significance of nonnecessitating grounds next. For more on a metaphysics of mind that permits ungrounded thoughts even in a broadly physicalist framework, see, *inter alia*, Bailey (forthcoming), Bailey and Rasmussen (forthcoming), and Rasmussen (2018).

- <sup>19</sup> Axiom N is not without controversy. Fine (2012a, 2012b), Rosen (2010), and Trogdon (2013b) endorse a close cousin of this thesis, while Skiles (2015) challenges it.
- <sup>20</sup> This procedure not only gives us coherent thoughts but also coherent *narrow* contents of thoughts—i.e., intrinsic elements that can be apprehended in first-person awareness.
- <sup>21</sup> Lewis (1986, pp. 104–108) claims that some *propositions* are unthinkable. But note that Lewis' propositions (understood as sets of worlds) are importantly different from the thoughts we have identified. Lewis' propositions include worlds as members, while we identify types of thoughts that obtain within worlds. Our procedure explicitly identifies perfectly coherent thoughts in terms of more basic conceptual elements. By contrast, any procedure for defining thoughts in terms of *sets of worlds* containing thoughts results in circular definitions (not to mention more thoughts than thoughts). Our procedure avoids self-definition because we define thoughts in terms of grasping *non-mental* grounds. On grounding circularity, see Bliss (2013) and Bliss (2014).

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