The Actuals

Actuality, uniqueness, and physical necessity

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Abstract

What earns the claim that a physical relation is *the* morality, economics, or meaning of reality? Recognition Science locates these subjects in the same physical structure. The decisive step is to show how that structure determines the particular relation concerned. We distinguish physical identification, unique determination, and necessity across realizations. For binary questions with independently specified observations and comparisons, we derive an exact criterion: every question must be reached from an observation, and all paths to it must agree. A disagreeing account must lose a determining fact. This determination extends across realizations that faithfully preserve those facts, including the permitted histories. A calibrated comparator exhibits the derivation of an unknown reporting function. An authored undertaking shows why history and capacity matter even when present costs agree. A unique relation can permit several performances and actual violation; its necessity fixes the distinction between them.

1 The claim made by the definite article

To call an account *the moral code of reality* makes a stronger claim than saying that its rules fit some observations or express a coherent preference. It claims that a relation belongs to reality itself and that no alternative relation could do the same physical work while giving different answers to the same fully specified questions. The same issue arises when speaking of the actual cost of a comparison, the meaning of a retained distinction, or a purpose intrinsic to a physical process.

Recognition Science begins with distinguishable occurrences, comparisons requiring information about their terms, and retained records whose later examination is another occurrence. Its physical derivations establish what those operations force under their stated conditions [3]. Ethics concerns the participants, bonds and effects within that structure. Economics concerns their resources, production and exchanges. Meaning concerns what an authored record preserves and enables another participant to enact. The claim of actuality identifies the physical relations themselves as the subject matter of these domains [6, 7, 9].

These identifications have concrete mathematical content. In a comparison-and-repair construction, supplied actual and required comparison states determine an economic action whose

successor is exactly the same bond ledger used to evaluate its ethical effects. Identifying those comparison signals with the physical situation is part of the derivation. A specified recording channel retains the original comparison, its author and its order so that another participant can recover and enact the same ledger transformation [7]. The economic, ethical and communicative descriptions agree about the objects and what happens to them.

The central question is how necessity in this shared architecture carries through to a particular relation within it. A unique architecture need not make every arbitrarily proposed relation unique. The architecture must settle the relation in question. An actual undertaking provides a concrete instance: its terms, acceptance, displaced alternative and available remedy are physical facts. Determining fulfillment from those facts and deriving their moral authority are distinct tasks. Both concern the same participants and history.

Three claims need to be kept distinct. A relation is *actual* when it is instantiated by physical objects, operations, or histories. A relation is *uniquely determined* when the requirements of its identified role leave exactly one compatible answer throughout its domain. It is *necessary across a class of realizations* when every member of that class must preserve the determining requirements and hence the same answers. A particular event can be actual without being inevitable. A necessary law can govern many different events.

The physical interpretation matters at the beginning. A calculation about an abstract relation does not, by itself, show which physical relation it describes. One must identify what the variables refer to, how the operations act, and why the requirements belong to the thing being studied. Once that connection is made, necessity can be proved by excluding alternatives under the same conditions. The candidate relation must remain unrestricted, and the determining requirements must be justified independently of the proposed answer.

The passage from architecture to an actual relation has three parts. Physical identification establishes what the questions concern. Independent determining facts fix their answers throughout the domain. Preservation of those facts extends the answers across admissible realizations. For binary observations and preserve-or-reverse comparisons, coverage and agreement give an exact criterion. They also locate a fact that any disagreeing account must lose. The substantive issue is why the constraints belong to the identified physical subject and what a faithful description must preserve. This issue connects familiar methods of implicit determination to claims of physical necessity.

Necessity concerns the governing relation across the permitted histories. It need not select a single event or future. Several acts may fulfill one undertaking, and an executable act may violate it. Likewise, describing only the history that occurred can omit alternatives needed to determine what was possible, fulfilled or owed. A complete representative of the physical architecture must retain those alternatives when they bear on the question.

2 Leave the candidate relation unknown

Suppose we ask whether a particular action fulfills an accepted undertaking. The question identifies the participants, retained terms, relevant history, action, and checkpoint. Asking whether that action is physically possible is a different question. Asking whether it is owed is different again. A proof must retain the question it set out to answer.

Represent a fully addressed question by q. A candidate law assigns a yes-or-no answer to each question. This does not restrict a law to simple subject matter: membership in a relation can be asked in this form. It does restrict what the present theorems directly examine. Their exact criterion concerns binary observations and comparisons that preserve or reverse answers. Other kinds of constraint may determine a relation by other means.

Two candidates are rivals only where they disagree about the same addressed question. Hold its physical facts fixed and ask whether both candidates remain compatible with them. If they do, those facts have not selected one answer. If every rival is excluded, the answer has been determined without requiring that we encounter every rival in nature. This is a question of implicit determination. The strategy of holding one interpretation fixed while varying another is associated with Padoa's method [1].

The independence of the requirements is substantive. A report that reads a number from an instrument is independently specified only when the instrument and its reading are identified without consulting the candidate law. A record of accepted terms can settle what satisfies those terms. Calling that record a direct reading of moral authority needs its own physical justification. Writing the desired moral verdict into a probe would place the conclusion among the premises. The identified subject also fixes which constraints a rival must preserve: omitting a requirement of the actual apparatus or replacing the accepted terms changes the question being answered.

3 An exact criterion for unique determination

Let Q be a set of questions. A candidate law is any function $L : Q \to \{0, 1\}$. A *probe* (q, b) fixes an answer b at q. A *comparison* (q, r, s) says that the answer at r preserves the answer at q when $s = 0$, and reverses it when $s = 1$. Write $\oplus$ for addition modulo two. A compatible law satisfies every supplied constraint:

$$L(q) = b, \qquad L(r) = L(q) \oplus s.$$

The probes and comparisons are given before the candidate law. Their physical justification is part of the application.

Starting from a probe, carry its bit along a finite path of comparisons. Reverse the bit at each comparison with sign one. A bit is *reached* at a question if some such path ends there with that bit. A zero-length path is permitted. A comparison may be read in either direction because reversing the same bit twice restores it; this inferential fact requires no reversal of a physical process. The preserve-or-reverse path structure is closely related to signed graphs [2]. The question set itself need not be finite.

Theorem 1 (Unique determination)**.** *Exactly one compatible law exists if and only if:*

(i) *every question is reached from a probe;*
(ii) *any two paths reaching the same question give the same bit.*

If at least one compatible law exists, all compatible laws agree at a given question exactly when that question is reached.

Proof. A compatible law agrees with the initial probe of any path. Each comparison forces the next value, in either direction. Induction on path length therefore shows that the law agrees with every reached bit. Conflicting reached bits exclude every compatible law.

Suppose (i) and (ii) hold. Assign to each question its reached bit. Condition (i) supplies a bit and (ii) makes the assignment independent of the chosen path. A probe is a path of length zero, so its value is respected. Extending a path by one comparison gives exactly the required value at the other endpoint. The assignment is therefore a compatible law. Every compatible rival agrees with each reached bit, and every question is reached, so the law is unique.

For the converse and the pointwise assertion, start with a compatible law. An edge cannot join a reached question to an unreached question: traversing the edge would reach the latter. Complement the law's answer at every unreached question and leave every reached answer alone. Every probe remains unchanged. The endpoints of each comparison are either both reached or both unreached. Complementing both endpoints preserves their agreement or reversal, so the modified law is compatible. If a question is unreached, this law disagrees there. Thus uniqueness requires (i), and the initial path argument gives (ii). The same construction proves the pointwise assertion. □

The theorem constructs the law; it does not begin by assuming that the proposed law is the unique one. Its two conditions have different jobs. Coverage rules out remaining freedom. Agreement rules out contradiction among the answers that have been derived. The existence qualification in the pointwise statement cannot be omitted: an inconsistent set of constraints may admit no law at all.

Corollary 2 (Local results determine one relation)**.** *Suppose separately obtained reports have physical addresses and binary answers. Exactly one unrestricted law fits all the reports if and only if every address has a report and all reports at the same address agree.*

Proof. Use the reports as probes, with no comparisons. Reached answers are exactly reported answers, so Theorem 1 applies. □

This is the sense in which independently derived pieces can form *the* relation. A long list of correct pieces establishes neither coverage of an omitted part nor agreement at an overlap. Both must be accounted for.

4 A different answer must lose a determining fact

A proof of determination can say more than that a rival is wrong. It can identify what the rival would have to give up.

Take a finite path deriving answer b at question q in one physical description. Retain its starting probe and the comparisons it actually traverses. Let f translate the questions into a second description, and let L' be a law compatible with that description's constraints. Preserving a path fact means preserving the probe outcome, or preserving the comparison's endpoints and its sign, under f.

Theorem 3 (A disagreement has a witness)**.** *If $L'(f(q)) \neq b$, at least one probe or comparison on the original derivation fails to hold after translation.*

Proof. Suppose instead that all those facts are preserved. Transport the initial probe. Then transport each comparison in the order of the derivation, carrying the same bit and reversing it at the same steps. This constructs a path deriving b at $f(q)$. Every compatible law in the second description must agree with that path, by the first part of Theorem 1. Hence $L'(f(q)) = b$, a contradiction. □

The witness lies on the derivation of this answer. A change elsewhere in a universe is irrelevant unless it changes a fact that the argument uses. Conversely, the theorem does not claim that every physical difference changes the answer.

For the witness to be a physical difference, both descriptions must faithfully represent the facts at issue. Missing a measurement from a notebook is not the same as changing reality. The theorem says that a disagreeing compatible account cannot retain every determining constraint. When those constraints describe actual operations and outcomes, the rival must either describe different physical facts or cease to be a faithful account of the same case. Merely renaming the participants supplies neither possibility.

5 One relation across physical realizations

Different realizations may use different objects and names to describe the same physical question. Local uniqueness alone does not establish agreement between them. The correspondence must preserve what the question addresses.

Let w range over a specified class of realizations. Its local questions form Q_w, with their own probes and comparisons. A map $a_w : Q_w \to A$ gives their physical addresses. Every address in A is realized by at least one local question. The maps are specified independently of the candidate answers.

A code $C : A \to \{0, 1\}$ *governs throughout* if its restriction $q \mapsto C(a_w(q))$ fits each realization and every compatible local law agrees with that restriction. In particular, local rivals are not required in advance to be copies of a single code.

Theorem 4 (Determination across realizations)**.** *Exactly one code governs throughout if and only if:*

(i) *every question in every realization is reached from a local probe;*
(ii) *any two paths reaching questions with the same physical address give the same bit, whether the paths occur in the same realization or in different ones.*

Proof. If a code governs throughout, its restriction is compatible and every local rival agrees with it. The pointwise part of Theorem 1 gives (i). Every reached bit equals the code's value at its physical address, giving (ii).

Conversely, choose any address. It has a local representative, and (i) gives a path reaching that representative. Define the code at the address to be the path's bit. Condition (ii) makes this definition independent of the path and the representative. A probe gives a zero-length path; extending a path by an edge gives the required comparison equation. The restriction therefore fits each realization. Every compatible local law agrees with its reached bits and

hence with that restriction. Every address is realized, so no other governing code can differ anywhere on A. □

One can establish agreement by transporting the determining operations. A map preserving the starting probe and each comparison carries a reached bit to the same bit, by induction on the path. The identification of physically identical addresses remains essential. Assigning each realization a private set of unrelated addresses would remove the cross-realization question. Including the desired answer in an address would assume the agreement to be proved.

6 Why one possible architecture is enough

Suppose reality has only one possible physical architecture. A representative of that architecture must include all cases and histories the architecture permits. It cannot consist only of the events that happened to be observed along one history.

The precise role of this premise is transport. To use it, show that each admissible realization has a faithful, reversible description in the representative: questions correspond, and the probes and comparisons are carried exactly to the corresponding probes and comparisons. A shared diagram or a shared name for the architecture does not establish this correspondence.

Corollary 5 (One representative suffices)**.** *Suppose a reference question space has exactly one compatible law. Suppose every admissible realization is related to it by mutually inverse translations preserving the full probe and comparison basis. Then every compatible law in every realization is exactly the transported reference law.*

Proof. Take any compatible local law and bring it back along the translation to the reference space. Preservation of the basis makes the resulting law compatible there. Reference uniqueness fixes it. Translate forward using the inverse map. This fixes the local law at every question. Conversely, transporting the reference law preserves the defining equations, so it gives a compatible law in each realization. □

There is no demand here to observe other universes. The quantifier over realizations is discharged by showing what any realization must preserve. Theorem 1 can supply the reference uniqueness, while Corollary 5 supplies its necessity across realizations. Theorem 3 then explains exactly what a disagreeing answer would have to change.

The local determination step is indispensable. Even a single fixed carrier can admit two readings. Let its questions be 0 and 1, let its only probe require answer zero at question zero, and give it no comparisons. The constantly zero reading and the reading that returns the question's own bit both fit. They disagree at question one without changing the carrier or any supplied fact. The architecture is fixed; the proposed question remains unsettled by these constraints.

This example does not undermine the possibility of a forced relation. It identifies the work that earns the claim. One must derive the relation's answers from the architecture's determining features. Once that work is done, the unique-architecture premise extends it beyond a single presentation of reality.

The scope of necessity also depends on existence. A structure may determine what follows whenever an undertaking is formed without requiring an undertaking to be formed in every history. The law and a particular instance of the law are different objects. The formal framework even permits an empty question domain; the physical examples below supply nonempty instances.

7 A physical example: the comparison cost

A calibrated comparator shows what it means to leave a function unknown and derive its form from the apparatus. The native reporting construction in Recognition Science identifies the operand pulses, their residual, and the reference read by the same detector [3]. For positive integer operand counts a, b, the unit-calibrated reading is

$$\frac{(a-b)^2}{2ab}.$$

The normalization is a specified physical reference operation. It is not chosen after observing which function would be convenient.

Let F be an unknown report on positive ratios. Require it to agree with those readings and to be continuous for positive real arguments. On $x = a/b$, the apparatus then requires

$$F(x) = \frac{(a-b)^2}{2ab} = \frac{x + x^{-1}}{2} - 1 = J(x).$$

Every positive rational is represented by such an operand ratio. Both F and J are continuous on the positive reals, so agreement on the dense positive rationals forces equality throughout that domain. The displayed function itself supplies existence. These requirements therefore determine one report.

This example uses density and continuity rather than the finite paths of Theorem 1. The general lesson is the same: identify the physical requirements independently, prove that they settle the unknown, and show that the proposed expression meets them. The exact path criterion is not being claimed as the only possible form of physical determination.

The conditions retain their force. Integer-operand readings alone would not constrain a changed value at an irrational argument. A different detector reference can change the normalization. The unique conclusion belongs to the stated reporting problem, with its actual reference and continuity requirement. It does not assert that every quantity called cost is J.

Here *actual* refers to the reporting relation of the identified comparison apparatus, and *the* is earned by its uniqueness. Its extension to all admissible realizations requires those realizations to retain the apparatus conditions. This is an instance of the proposed proof structure, rather than an analogy between physics and an unrelated subject.

8 Authored care: fulfillment and authority

Consider a helper who offers maintenance and a recipient who accepts it. In the care construction, the recipient responds by performing a service instead of feeding herself [4, 5]. The response rule, available food, repair dynamics, accepted terms, and participants are specified physical features of the case. After the service, the helper can feed her or wait.

The accepted content requires the recipient to remain balanced with positive reserve at the delivery checkpoint. At the first checkpoint after that service, waiting leaves her balanced but with zero reserve. Feeding leaves her balanced with positive reserve and restores the recipient state she would have reached through self-provision followed by waiting. Both actions leave the helper able to continue at that checkpoint. The physical distinction is not removed by the helper preferring to wait.

The two outcomes have the same present bond cost. At this checkpoint each compared endpoint has bond multipliers equal to one, with cost $J(1) = 0$; each participant's repair payments also agree between the branches [8]. Yet one action leaves the recipient with positive response capacity and the other exhausts it. Present cost and repair payments therefore do not determine fulfillment. The physical description must retain the reserves, accepted content and causal history that distinguish the outcomes.

The displaced alternative makes the history consequential. Without the accepted undertaking, the specified recipient response is self-provision. Acceptance redirects that action into service, leaving the recipient dependent on the helper's delivery. Delivery restores the recipient to the no-reliance response state while costing the helper labor. The relation identifies who undertook what, whose alternative was spent, and who controls the available remedy. These are facts about the same physical process. A description that retains only an endpoint cost has discarded part of that process.

Ask the narrow question: does waiting fulfill this accepted undertaking at this checkpoint? With the named terms, recipient, history, and response dynamics fixed, the answer is no. An account that calls it fulfillment has changed or disregarded something determining the comparison. In this specified physical construction, fulfillment concerns retained terms and effects on the identified recipient. Once those features are fixed, waiting fails the condition even though the helper can choose it.

The relation is more precise than a command to carry out one complete future. Different food units can produce the required first-feed effect. A unique condition of fulfillment can therefore admit several performances. The general word *the* need not mean that every action, institution, history, or physical object has only one realization.

Now consider the broader question: is this requirement what the helper owes the recipient? Its answer must account for the authored agreement, the recipient's displaced alternative, and the helper's control of restoration. The further derivation is why this authored relationship has moral authority, including when the helper chooses to violate it [6, 8]. Calculating fulfillment identifies the action's relation to the accepted terms; establishing authority identifies why the requirement governs the helper. A controller that executes a specified rule settles which rule that controller implements. The authority of that rule requires its own grounds in the physical relationship.

The moral application therefore makes the proof obligation exact. A proposed moral relation must be grounded independently enough that rivals can be compared against the same facts. If those facts settle every addressed question and their answers agree, there is one compatible relation. If all realizations of the forced architecture preserve those determining features, the relation is necessary across them. Establishing this criterion and completing the derivation of the moral relation are separate results.

9 Identifying the actual thing

Proving that reality determines one relation and showing that a particular account expresses it are separate steps. Their connection is short.

Corollary 6 (Identification of a proposed code)**.** *In the setting of Theorem 4, suppose C governs throughout. If a proposed code M, restricted to each realization, satisfies every independently specified probe and comparison, then $M = C$ on all realized addresses.*

Proof. Choose a local question at any realized address. The restriction of M is a compatible local law. Since C governs there, the two give the same answer. Every address is realized, so the codes agree everywhere on their domain. □

This establishes the logical structure of earning *the*. Identify the physical subject and its requirements. Show that those requirements admit an answer and exclude every rival. Establish why every admissible realization must preserve the determining facts. Then show that the proposed account is that answer. A definition of compatibility helps state this work; it does not replace the physical grounds for its constraints.

The question is related to logical independence, rather than to a claim that an incomplete formal system can decide all truths. We compare interpretations of a particular relation while holding its determining structure fixed. No result here asserts that every physical question is decidable, that every structure has a finite description, or that every arbitrary relation is forced. The proofs specify when the relation under study is determined and how that determination survives a change of realization.

For morality, economics or meaning, a claim to actuality must identify the participants, operations and histories concerned. A claim to uniqueness must show that independently grounded facts determine every addressed case. A claim to necessity must establish preservation of those facts throughout the stated class of realizations. In the binary setting, the theorems give exact conditions for the last two steps once the physical basis is identified. The comparison cost supplies a different determination argument through density and continuity.

These obligations make the definite article assessable. One can examine the physical identification, look for an unanswered case or conflicting derivations, check the correspondence between realizations, and test whether the proposed account satisfies the determining facts. With one possible architecture, necessity runs through what every faithful realization must retain. Once those facts fix a relation, a different faithful answer to the same case requires a different determining fact. That is what earns the word *the*.

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