

## THE PERILS OF CONFUSING NESTING WITH CHAINING IN PSYCHOLOGICAL EXPLANATIONS

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**ABSTRACT:** Despite its diminished importance amongst philosophers, the deductive-nomological framework is still important to contemporary behavioral scientists. Behavioral theorists operating within this framework must be careful to distinguish between nesting and chaining. Explanations are chained when the explanandum sentence of one explanation is one of the antecedent conditions of another. They are nested when one of the antecedent conditions or the explanandum sentence of one explanation is one of the covering laws of another. Confusion between nesting and chaining leads to explanation nests that cannot be nomologically entrenched. They cannot, even in principle, be logically connected to laws arising from other sciences. This hazard should be particularly important for evolutionary psychologists to avoid, since many evolutionary psychologists tend to see themselves as dedicated to both nomological entrenchment *and* cognitive functionalist models. The hazard can be avoided if the intentional constructs of the behavioral sciences are construed not as ineffable and inaccessible antecedent conditions, but as complex, law-like patterns in behavior.

*Key words:* explanation, Hempel, evolutionary psychology, New Realism, behaviorism

### **The Perils of Confusing Nesting with Chaining in Psychological Explanations**

For more than a decade we have been working on the implications of Hempelian analysis of the social sciences sketched by Rosenberg (1988) in his *Philosophy of Social Science*. While perhaps out of fashion in philosophical circles, the deductive-nomological pattern of thinking is still widely embraced in the behavioral sciences (i.e., behavior scientists still frequently conceptualize their

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investigations as seeking to falsifying logical deductions from theory). Thus, we think our exploration and elaboration of Rosenberg's views has been useful in identifying some pitfalls in behavioral explanation and in suggesting how these pitfalls might be avoided (Derr & Thompson, 1992; Thompson & Derr, 1995, 2000). In the meantime, the need to make the social and behavioral sciences compatible with the biological and physical sciences has been reemphasized by the flowering of the field of evolutionary psychology, which seeks to bolt the behavioral sciences firmly to the bedrock of evolutionary biology. Cosmides, Tooby, and Barkow (1992), in a manifesto<sup>1</sup> that evoked the Unity of Science movement of the 1930s, declared that psychology would not be made honest as a field until each of its concepts and findings was related to the biological and physical sciences. Thus, we think, despite contemporary misgivings about Hempelian philosophy of science, a clearer understanding of the problems Rosenberg raised, as well as the proposals for solving those problems, is as necessary now as it was when we began working with Rosenberg's ideas more than a decade ago.

### **A Critique of Rosenberg's D-N Approach to Mental-Kinds Explanations**

Rosenberg argued, persuasively and influentially, that the social sciences' "failure to thrive" should be blamed on the intentionality of their core explanatory concepts. Intentional concepts are those that take propositions about the world as objects of verbs of mentation such as thinking, believing, feeling, fearing, etc. They are of the form E1 (an event) happened because A (agent) M'd that E1 where M stands in for any verb of mentation.<sup>2</sup> Intentional statements are "opaque" in two curious ways. They are existentially opaque in that the state that is the object of mentation need not be a possible state of affairs, and they are referentially opaque in that they are necessarily true only from the point of view of A. Consider the statement that Jones avoided Central Park because he thought unicorns were living there. This statement might be true because A believes that horses with horns on their noses are living in central park or because he has been told that unicorns are small grey arboreal creatures with long fuzzy tails. In neither case does the factual truth of A's belief play any part in our evaluation of the truth of the explanation of his avoidance of Central Park. Only the factual truth of his believing matters. Because intentional concepts display this existential and referential opacity, Rosenberg argued that they cannot be "nomologically

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<sup>1</sup> Their evangelism leads them to write some wonderfully purple prose, e.g., "... After more than a century, the social sciences are still adrift, with an enormous mass of half-digested observations, a not inconsiderable body of empirical generalizations, and a contradictory stew of ungrounded, middle-level theories expressed in a babel of incommensurable technical lexicons" (p. 23). We certainly would not choose to be adrift in a stew like that!

<sup>2</sup> Actually, the E2 M'd may or may not be E1; that is, Jones may have been run down by a fire truck because he feared the fire just as he may have escaped the fire because he feared it.

entrenched”—that is, they cannot, even in principle, be logically connected to the more fundamental scientific laws developed in the disciplines of biology, chemistry, and physics. Thus, according to Rosenberg, to the extent that explanations in the social sciences rely on intentional concepts, they are inherently and irreversibly cut off from the presumably deeper and more universal explanatory systems of biology, chemistry, and physics.

Rosenberg’s argument is deployed within a broadly Hempelian account of explanation in which explanations are thought to be derived from “covering laws,” exceptionless generalities about events in the world. By combining a law that relates a class of antecedent conditions to a class of consequences to the occurrence of one of the consequent condition, a Hempelian explanation gives us an opportunity to test the law by looking for the consequence in the presence of the antecedent. Failure of the consequent to follow from the antecedent would seem to undermine the law. Our earlier articles argued that Rosenberg’s criticisms are valid only if one adopts a particular (albeit popular) construal of how intentional propositions should be deployed in Hempelian social scientific explanation—namely, the view that propositions containing intentional terms enter into Hempelian explanations as statements of antecedent conditions.

Fortunately, Hempel and Oppenheim’s (1948) classic account of explanation offers another possibility: propositions containing intentional terms participate in explanations not as antecedent conditions but as covering laws. And, as our earlier articles argued, this alternate construal of intentional terms undermines Rosenberg’s argument and opens the way for the nomological entrenchment of social scientific explanations. Thus, we argued, propositions containing intentional terms (e.g., “Jones wanted to stay dry”) should be construed not as statements describing a particular antecedent condition, but rather as covering laws that describe a recurring pattern of behavior and that nomologically link the various named antecedent conditions to the behavior being explained.<sup>3</sup>

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<sup>3</sup> Readers familiar with Hempel might note here a violation of Hempel’s dictum that laws be universals. We have dealt with this objection in an earlier essay in this series:

One might object that the motivation statements and other claims here construed as covering laws are vulnerable to a new objection, namely, that because they refer to a particular entity (Jones) they cannot qualify as lawlike sentences. Indeed, Hempel and Oppenheim (1948) did require that covering laws have universal logical form, and since our motivational claims do refer to a spatio-temporally particular object, they might seem to be disqualified as Hempelian covering laws. But at least two replies can be made against this objection.

First, Hempel himself later pointed out that mention of spatio-temporally particular objects cannot be used to exclude otherwise lawlike sentences as potential scientific laws (Hempel, 1965, p. 458, footnote 4). Second, the requirement of universal logical form has not stood the test of time—and, in particular, the test of more sophisticated history of science—as well as Hempel’s other criteria. Many of the greatest scientific advances, including both Kepler’s

On this view, social scientific explanations are not made problematic by the use of intentional propositions; they are made problematic only if such propositions are mistakenly construed as statements of antecedent conditions. When intentional propositions are correctly construed as covering laws, Rosenberg's problem of nomological entrenchment disappears. Thus, on our account, when intentional propositions are understood as generalities about how one or more agents behave in a specified set of circumstances, then psychological laws are as open to nomological entrenchment as their physical counterparts.

That appeals to intentionality present no insuperable barrier to nomological entrenchment is good news for the behavioral sciences. Clearly, many of the central concepts used in ethology, psychology, and behavioral biology—and perhaps even genetics and physiology (Thompson & Derr, 2000)—display intentionality. However, even if intentionality need not *necessarily* block nomological entrenchment, Rosenberg is surely correct to point out that the disciplines most dependent on intentional concepts are also the disciplines least successful so far in constructing accepted theoretical networks characterized by such entrenchment. Thus, it seems worth asking: What features of intentional explanations invite such failure?

Our suggestion is that construing intentional propositions as antecedent conditions blocks a nomologically entrenching process that here we will call “explanation nesting,” a process that embeds an explanation within a matrix of laws. Explanatory nesting is characteristic of all the physical sciences and is the principle means by which their theoretical and explanatory networks are successively linked to theories of more general scope and greater ontological

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laws of planetary motion and Galileo's laws of terrestrial dynamics, refer to spatio-temporally particular objects (the sun in the former case; the earth in the latter).

Some would argue that Kepler's and Galileo's laws were genuinely scientific only because they are derivable from higher-order scientific laws (for example, Newton's laws of motion and gravity) which do not themselves refer to any spatio-temporally particular object. But this defense of Hempel's original view has its own problems. As applied to history, it would imply that before the publication of Newton's laws, neither Kepler's nor Galileo's laws could be used in valid scientific explanations—an odd claim at best. And as applied to the contemporary problem of motivational explanation, it would constitute an objection to our proposed reinterpretation only if it is assumed that the covering laws describing Jones's behavior will themselves never be derivable from more general laws—for example, from laws that relate histories of reinforcement or millennia of natural selection to the general forms of behavioral design and to the particular design of Jones' dry-keeping behaviors. Surely, it is no more difficult for contemporary social scientists to anticipate such general laws than it might have been for early Copernicans to anticipate Newtonian physics (pp. 41-42). (Derr, P. & Thompson, N. S. [1992]. Reconstructing Hempelian motivational explanation. *Behavior and Philosophy*, 20[1], 37-45)

depth. At the outset, it will be necessary to distinguish two different kinds of explanatory linkages: nesting and chaining.

### Nesting and Chaining in Everyday Physical Explanations

In the familiar Hempelian account of an explanation (E), an event—say, the shattering of a favorite antique brandy snifter—is explained by adducing antecedent conditions (A) and physical laws (L) that causally relate the antecedent conditions to the explanandum sentence (C).

(E)	A1:	The snifter fell onto the floor.
	A2:	The floor was hard.
	L:	Snifters are brittle (i.e., <i>ceteris paribus</i> , snifters shatter when struck by hard objects).
		_____
	C:	The snifter shattered on the floor.

We are accustomed to linking multiple physical explanations like these in two quite different ways. The first may be called “chaining” and the second “nesting.” Explanations are *chained* when we use the consequence (C←) of a prior explanation (E←) as an antecedent condition (A) of a later one. For example, we might chain the explanation about the shattering of the snifter (E) backward in time to provide an account (E←) of how the snifter came to fall. Thus:

(E←)	A1←:	The snifter was at the edge of the coffee table.
	A2←:	The cat pushed the snifter off the edge.
	L←:	Unsupported objects fall.
		_____
	C←(=A):	The snifter fell onto the floor.

Or we could chain the explanation about the shattering of the snifter (E) forward in time to provide an account (E→) of how glass happened to be scattered all over the floor of the living room. Thus:

(E→)	(C=)A1→:	The snifter shattered on the floor.
	A2→:	The floor was flat and slippery.
	L→:	Objects that shatter on flat, slippery surfaces tend to scatter their pieces widely.
		_____
	C→:	Pieces of glass were scattered widely.

As Hempel and Oppenheim (1948) note, such causal chains are so familiar that in providing informal explanations we typically invoke them in highly elliptical fashion, leaving many of the relevant covering laws and antecedent conditions unstated. Thus, in reply to the question: “Honey, why is there glass all over the living room floor?” We might provide the highly elliptical response: “The cat got into the living room after the party last night,” leaving it to the hearer to supply both the chain of antecedents ( $A \rightarrow, \rightarrow \rightarrow, \rightarrow \rightarrow \rightarrow$ , etc.) and consequences ( $C \rightarrow, \rightarrow \rightarrow, \rightarrow \rightarrow \rightarrow$ , etc.) that connect the scattered glass with the errant cat, as well as the covering laws about glass and cat behavior that connect each antecedent with its consequent.

The second way in which we routinely link multiple physical explanations is “nesting.” *Explanations are nested when we use the consequence ( $C \uparrow$ ) of a deeper explanation ( $E \uparrow$ ) as a covering law ( $L$ ) in a shallower one.* In nesting, the “nested” covering law is itself explained, i.e., it is the explanandum of an explanation whose explanans deploys covering laws that are deeper or more general than the law being explained. For example, we might nest ( $E$ ) under ( $E \uparrow$ ) by invoking laws that connect brittleness to molecular structure. Thus:

( $E \uparrow$ )	$A \uparrow$ :	Snifters are composed of a material with molecular structure M.
	$L \uparrow$ :	Objects with molecular structure M are brittle.
		—————
	$C \uparrow (=L)$ :	Snifters are brittle.

Furthermore, we might nest  $L$  downward, by using the fact that the snifters are brittle as a causal antecedent to explain other generalities about them. Thus:

( $E \downarrow$ )	$A \downarrow$ :	Snifters are brittle.
	$L \downarrow$ :	Brittle objects have a short useful life.
		—————
	$C \downarrow$ :	Snifters have a short useful life.

Conceptualizing nesting and chaining in this way suggests why a successful explanation often has heuristic fertility. The possibility of explanatory chaining invites us to investigate the causes of the antecedent conditions cited in an explanation and perhaps to also consider what further consequences might be explained by reference to the state of affairs described in its explanandum sentence. The possibility of explanatory nesting invites us to find deeper or more general laws that might be used to account for the particular laws deployed in an explanation, or if its explanandum is law-like, to consider whether there are useful but more particular laws that it might explain.

Nomological entrenchment is a natural consequence of explanatory nesting and chaining, because any successful scientific explanation typically raises at least the following four questions:

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- Q← How can the antecedent conditions of my present explanation be explained? (How can I chain this explanation backwards in time?)
- Q→ What work can the explanandum sentence of my present explanation do. (How can I chain this explanation forward in time?)
- Q↑ How can the covering law of my present explanation be explained? (How can I nest this explanation under deeper and more general laws?)
- Q↓ What more particular laws does the covering law of my present explanation imply. (Are there other laws that I can nest under this explanation?)

This characterization of nomological entrenchment has an additional advantage that we will exploit below. It makes evident one possible source of mischief in explanation—namely, confusing nesting with chaining. Imagine that instead of construing the disposition “being brittle” as law-like (= “*ceteris paribus*, breaks when struck by a hard object”), we were to construe it as a condition antecedent to breakage. Then the explanation of breakage takes the following form:

- |     |     |   |
|-----|-----|---|
| (E) | A1: | <i>The snifter was brittle.</i>                       |
|     | A2: | The snifter fell.                                     |
|     | A3: | The floor was hard.                                   |
|     | L:  | Brittle snifters shatter when struck by hard objects. |
|     |     | —————   |
|     | C:  | The snifter shattered.                                |

Recasting the explanation in this form does little to change the chaining relation, since it simply adds brittleness to the causal antecedents to breakage and does not affect those already present. But it alters the nesting relation because the covering law changes: The law that related striking to breakage is now a law that relates, among other things, brittleness to breakage. So the question is, “Is it possible to nest such a law?”

To nest such a law upward, we would need to find an explanation (E↑) that produces “brittle snifters shatter when struck by hard objects” as its explanandum sentence; that is, we need to answer the question “Why *do* brittle snifters shatter when struck by hard objects?”

Two answers naturally come to mind. The first answer is “because brittle objects have molecular structure *M*.” On this interpretation, the fact that brittle objects break when struck by hard objects is explained by their molecular structure. But this same molecular structure has already been cited in our explanation of the statement “the snifter was brittle.” So this answer leads us to the

odd situation in which the same state of affairs ( $A \leftarrow$  and  $L \uparrow$ ) entails both the antecedent condition (A) and the covering law (L) of E.

The second answer that comes naturally to mind is “because they are brittle.” But this answer also blocks explanatory chaining because it is analytically true (clearly, all brittle objects are brittle!) and therefore lacks empirical content.

Thus, interpreting dispositions as antecedent conditions, rather than as covering laws, blocks nomological entrenchment by interfering with the normal process of explanatory nesting.

### Relation to Explanation in the Social Sciences

On this restricted revision of Rosenberg’s thesis, nomological entrenchment is blocked *only* when an explanation involves dispositions *and* those dispositions are construed as antecedent conditions rather than as covering laws.

Dispositional and intentional propositions both belong to a loose class of propositions called “law-like.” Dispositions, for instance, can be viewed as law-like statements of the form, “If X occurs, then Y occurs.” However, as we have observed, dispositions are sometimes viewed quite differently—namely, as place markers for antecedent conditions. The same ambiguity affects intentional statements. The statement that “Jones wants to remain dry” can be construed as a law-like statement relating rain-threatening circumstances to keeping-dry behaviors of Jones. But it can, alternatively, be construed as a place-holder for otherwise unspecified brain states or mind states that serve as antecedent conditions for Jones’s keeping-dry behaviors. Our thesis, *contra* Rosenberg, is that intentional propositions block nomological entrenchment only when they are so construed.

Explanatory nesting is not blocked for an intentional explanation if the intentional proposition appears as a covering law. Thus:

(E)	A:	Rain threatened.
	L:	Jones wants to remain dry: i.e., when getting wet is a possibility, Jones does keeping-dry activities such as carrying an umbrella.
		—
	C:	Jones carried an umbrella.

The explanation above can be chained backward by providing antecedent conditions and covering laws that explain the threat of rain (heuristic option  $Q \leftarrow$ , *supra*). It can be chained forward by providing covering laws that, in association with the statement “Jones carried an umbrella,” account for some causal consequent of umbrella carrying (heuristic option  $Q \rightarrow$ , *supra*). It can be nested upward by providing antecedent conditions and (deeper) covering laws that explain the law-like connection between threats of rain and Jones’s keeping-dry activities (heuristic option  $Q \uparrow$ , *supra*). Finally, it can be nested downward by providing laws



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that in conjunction with Jones's wanting to remain dry lead to other law-like propositions, such as "Jones tended to catch few colds" (heuristic option Q↓, *supra*).

But what if Jones's desire to remain dry is conceived of as an antecedent condition?

- (E)    A1:            Rain threatened, and  
          A2:            Jones wanted to remain dry, i.e., Jones  
                          was in a mental or physiological state of  
                          wanting to remain dry.  
          L:            People who want to remain dry carry  
                          umbrellas when rain threatens.  
                          \_\_\_\_\_  
          C:            Jones carried an umbrella.

This explanation can still be chained backward to explanations that account for the threat of rain and forward to explanations that use the carrying of an umbrella as an antecedent, but attempts to nest it will encounter the same sort of difficulties illustrated above. The question is: How is it possible to nest the law just above, which relates, among other things, wanting to remain dry to umbrella carrying?

To nest such a law *upward*, we would need to find an explanation (E↑) that produces "people who want to remain dry carry umbrellas when rain threatens" as its explanandum. That is, we need to answer the question "Why do people who want to remain dry carry umbrellas?"

As was the case with our attempt to nest E above, two answers naturally come to mind. The first answer will include some statement like "because the brains (minds) of people who want to remain dry are in brain-state (mind-state) X." This leads to an explanation-nest in which the fact that people who want to remain dry carry umbrellas is attributed to their brain or mind states. But here we encounter a problem: If wanting to remain dry is treated as an antecedent condition to umbrella carrying, then being in brain- or mind-state X will have already been cited as a cause of the wanting, so this attempt to nest upward ends up (as did the attempt to nest an explanation with a physical disposition as an AC) invoking the same antecedent condition to explain both the antecedent condition and the covering law of E.

The second answer that comes naturally to mind is "because they want to remain dry." But this blocks nesting because it is analytically true and therefore lacks empirical content.

### Conclusion

Two conclusions follow from this analysis. First, the use of intentional concepts and propositions in social scientific explanations need not block nomological entrenchment so long as the concepts and propositions are deployed

in ways that respect their law-like character. Dispositional explanations in the natural sciences are deployed and entrenched without difficulty because their dispositional statements are treated as laws, not as antecedent conditions. Observing the same scruples with respect to intentional explanations preserves their potential for nomological entrenchment.

Second, explanations are not immune to problems with nomological entrenchment just because they avoid intentional accounts. Cognitive theories that eschew traditional mentalistic concepts but use other sorts of law-like propositions in their explanations may also have serious difficulties with nomological entrenchment if the relevant law-like statements are misconstrued as statements of antecedent condition. Law-like propositions may be overt or deeply disguised as statements about structural entities or processes, as when a cognitive scientist refers to the fact that the success of a bit of behavior seems to presume some state of affairs as an “innate module” (Cosmides, Tooby, & Barkow, 1992) or “inner working model” ( Craik, 1943; Bowlby, 1969). If a “working model” is viewed as some sort of an obscure physiological condition antecedent to various sorts of adaptive behavior, rather than as a description of the bit of lawfulness implicit in the presumption, then explanatory nesting and nomological entrenchment will prove to be no easier than they would have been had traditional mentalistic concepts been used instead.

This hazard is particularly important for evolutionary psychologists to consider because many evolutionary psychologists are dedicated to both nomological entrenchment *and* to cognitive functionalist models. We foresee a struggle for the “mind” of evolutionary psychology. If, on the one hand, “mind” is construed as consisting of ineffable and inaccessible causes, then evolutionary psychology is doomed to float disembodied above the surface of the natural sciences just as its non-evolutionary predecessors have done. If, on the other hand, “mind” is construed as consisting of complex law-like patterns in behavior (Thompson, 1994; Thompson & Derr, 1993, 1995, 2000)—often metonymously attributed to individuals at particular places and instants, but visible only to an observer through intimate knowledge of the individual and across contexts and time—then, and only then, will evolutionary psychology be able to fulfill its ambition to become an integrative paradigm for the behavioral sciences.

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