Causality and Extensionality

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liberate action; knowledge invades pleasure; belief invades looking-to-one-as-if; knowledge invades perception. The source of these puzzles appears to lie in our conception of basic categories of attitude, predication, identity, substance. I have not seen a simple way of resolving the puzzles within current logical theory, or without.

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CAUSALITY AND EXTENSIONALITY

THERE is a use of a particular sort of argument to show that if a context is extensional—in a special sense which I will give—and if it involves the embedding of one proposition in another one, then that context is truth-functional. All that is required in the way of further assumptions (apart from the usual ones) is that logically equivalent sentences can be substituted for one another in the context *salva veritate*.

What is meant here by the context's being extensional is simply that designations of the same thing can be substituted for one another *salva veritate*. It is hardly to be entertained that this condition would hold and the one about logical equivalents not hold, so the further restriction doesn't seem to be more restrictive.

The argument I have in mind was first produced (so far as I know) by Quine in "Three Grades of Modal Involvement." [1] Related arguments—that is, using the same sort of trick but to different conclusions—appear in the version of his "Reference and Modality" in the 2d edition of *From a Logical Point of View* [2] and his *Word and Object*.[3] The kind of argument has some association with the name of Follesdal; and another version of the actual argument I am interested in here comes in Donald Davidson's article "Causal Relations" in this JOURNAL last year.[4]

The essential trick is to produce a designation of a class or of an object, or an open sentence, which incorporates an independent proposition as a conjunct. Our argument uses the description of a class [5]—say $\hat{x}(Gx \cdot p)$, assuming G to be a respectable class-forming

[1] *Proceedings, XIth International Congress of Philosophy, Brussels 1953*, vol. XIV (Amsterdam: North-Holland, 1954). Reprinted in *The Ways of Paradox* (New York: Random House, 1966).

[2] New York: Harper & Row, 1963; TB 566. [3] Cambridge, Mass.: MIT Press, 1960.

[4] LXIV, 21 (Nov. 9, 1967): 691–703.

[5] Or it could use the description of a number: the number of numbers n such that n is an even prime and p. This number will be 1 if p is true and 0 if p is false.

predicate. Let G be such that $\hat{x}(Gx)$ logically can't be empty. Then $\hat{x}(Gx \cdot p)$ is the same class as $\hat{x}(Gx)$ iff p is true. Also, the proposition saying that $\hat{x}(Gx \cdot p)$ is the same class as $\hat{x}(Gx)$ is logically equivalent to p itself. But also $\hat{x}(Gx \cdot p)$ will be just the same class as $\hat{x}(Gx \cdot q)$ whatever p and q may be, so long as they have the same truth value. For if they are both true, the class in question will be $\hat{x}(Gx)$ and if they are false it will be the null class.

Then we have an argument to show that if $F(p)$ is a context in which p is embedded and if the context is extensional in the sense mentioned, it must be a truth-functional context. For, as you can replace a proposition with any logically equivalent proposition *salva veritate,* you can replace p in the context by the proposition saying that the class of x's such that Gx and p is the same class as the class of x's such that Gx. And, as you can substitute designations of the same class for one another, you can replace the designation $\hat{x}(Gx \cdot p)$ by $\hat{x}(Gx \cdot q)$, whatever q may be, so long as it has the same truth value as p. And then you can replace the proposition saying that $\hat{x}(Gx \cdot q)$ is the same class as $\hat{x}(Gx)$ by its logical equivalent q. So you can derive $F(q)$. So the context $F(\ \ )$ is truth-functional.

I suppose someone might raise a howl about the artificiality of the procedure. I am not inclined to do so. The class description here constructed, for example, seems to be as determinate as G and p may be.

Donald Davidson uses an argument of this pattern to prove that the "logical form" of causal statements cannot be that of a connection of propositions. And similarly for temporal propositions. That is, the propositions:

p before q
p after q
p because q

disguise the true logical form of what is being said by their means. For—assuming that q is indicative in sense in all three cases—the truth of each of these demands the truth of both clauses. But the contexts are extensional. At least, they are if p and q are, which is all I need trouble about at this point. Therefore, by the formal argument, they must be truth-functional. But then you ought to be able to switch the clauses *salva veritate.* But you clearly can't. It follows, then, that the form of a connection between propositions is borrowed clothes, disguising the true shape of what lies underneath.

Before going further than this, let's ask, What *is* the relation between extensionality in the sense here given it, and truth-function-

ality? The argument considered proves that *if* you have a connection of propositions and extensionality reigns, then the connective is truth-functional. We can't say conversely that if you have a truth-functional connective extensionality reigns: that would exclude joining nonextensional contexts truth-functionally. What you can say is that if you connect extensional contexts truth-functionally, extensionality still reigns—an extensional context isn't going to become nonextensional by being connected truth-functionally with another context. Nor is a nonextensional context going to become *more* nonextensional by being embedded in a truth-functional context.

As far as the argument goes, then, it would seem that the argument gave us a demonstration of nonextensionality from non-truth-functionality, and nothing else at all. That is to say, if the provenance of the argument had been simply the discussion whether causal and temporal connectives constructed intensional or extensional contexts, it might have gone on like this:

> If a connective is extensional, it is truth-functional (proved).
> But these connectives are non-truth-functional, for the reasons given.
> ∴ These connectives are nonextensional.

It is only the conviction that the connectives must be extensional that leads to the conclusion that they are bogus connectives, i.e., don't truly represent the logical form of the propositions constructed by means of them.

I am inclined to accept the argument and not look for a way out. Its conclusion was not a surprise to me in respect of causal statements, and was so in respect of temporal ones. About the latter I will observe only that the nonextensionality comes out clearly enough when you have time-linked predicates in definite descriptions. You can have

John met Joan after they were married.

without provoking anxiety *de interpretatione,* but

The Emperor's baby son met his wife after they were married.

—where it is understood that the 'his' relates to the baby son—provokes the question, "Not *while* he was a baby, surely?" (The temporal connective 'after' here relates clauses rather than independent propositions, but that is immaterial.) Thus the conclusion of the argument that temporal connectives make contexts nonextensional is not after all outrageous.

Causal statements are usually simply asserted to be extensional—so long as their component clauses are extensional, that is—without

argument. Or perhaps a few examples are offered, and extensionality firmly asserted in respect of them, by way of (or in lieu of) argument. Consider

The child died because Joan is Rhesus-negative.

The child died because his mother is Rhesus-negative.

The child died because the tallest girl in town is Rhesus-negative.

or

There is an international crisis because "moi, de Gaulle" made a speech.

There is an international crisis because the President of the French Republic made a speech.

There is an international crisis because the man with the biggest nose in France made a speech.[6]

In response to the third of each set, just as we said, "But not while he was a baby, surely?" one also says, "But not *because* she is the tallest girl etc." or "not *because* his is the biggest nose."—Now of course those who believe causal statements to be extensional will give an account of the "greater explanatory force" of the second member of each trio. But the question here is not whether one can defend a thesis through thick and thin (we knew that already), but really whether there was originally any good reason for this thesis at all. Here I am in a bit of a difficulty. For I have no sure insight into the sources of the conviction that causal statements are extensional.

At any rate the comment "not *because* . . . is the _ _ _" offers a dilemma: either you must grant that this ". . . is the _ _ _" is not an identity proposition, or you must grant that *this* "because" context is nonextensional. For clearly the phrase 'the . . .' can't be regarded as *here* replaceable by some other designation of the same.

One idea that seems to be operating (though it has nothing especially to do with causality) is a crude Fregean sort of view of designating. For on that view we don't have to consider the *scope* of a definite description; definite descriptions and ordinary proper names are the same sort of expression, and the innards—the syntactical complexity—of a definite description don't make any difference, don't force us to qualify the comparison to a proper name. For of course I wouldn't want to deny that there was an international crisis because the man with the biggest nose etc., while granting that it did happen because moi de Gaulle did whatever it was.

[6] I owe this pleasing example, as well as the thought about temporal connectives, to P. Geach.

The case cries out for a Russellian kind of treatment; I mean a differentiation between:

> Concerning the man with the biggest nose: there was an international crisis because *he* . . .

and:

> There was an international crisis because the man with the biggest nose . . .

—the latter, since it is differentiated from the former, now being *false*—unless, as we say, "it was *because* his was the biggest nose."

This treatment involves allowing that difference of scope may make a difference even when a definite description is nonvacuous. In a footnote in "Reference and Modality" Quine contrasts Arthur Smullyan with Russell when Smullyan adopts such an idea to solve Quine's well-known problems about "Necessarily the number of the planets is greater than 7." At least he claims that Smullyan was departing from *Principia Mathematica* while, I suppose, ostensibly working within its framework. For he observes that Russell's theory of descriptions involved differences of scope, but adds that change in the scope of a description was indifferent to the truth value of any statement unless the description failed to name. "This indifference was important" he goes on "to the fulfillment, by Russell's theory, of its purpose as an analysis or surrogate of the practical idiom of singular description. On the other hand, Smullyan allows difference of scope to affect truth value even in cases where the description concerned succeeds in naming." [7]

Now Smullyan can't justly be charged with just playing fast and loose with the system of *Principia*. For Russell says, "But even when $E!(\iota x)(Gx)$, the incompleteness of $(\iota x)(Gx)$ may be relevant *when we pass outside truth-functions.*" [8] He gives a psychological example, as he usually does; the one exception I know is 'it is a strange coincidence that' [9]—and even that he probably regards as a psychological example, too. But the important phrase is that one: "when we pass outside truth-functions."

Quine could indeed quote various passages from Russell in which he says, in the "blurb" appended to his demonstrations, that "when $(\iota x)(Gx)$ exists, the fact that it is an incomplete symbol becomes irrelevant to the truth value of logical propositions in which

[7] *From a Logical Point of View,* p. 155, fn 9. The Smullyan article referred to is "Modality and Description," *Journal of Symbolic Logic,* XIII, 1 (March 1948): 31–37.

[8] Page 87, 1st ed.; p. 83, 2d ed. My emphasis.

[9] Page 77, 1st ed.; p. 73, 2d ed. This last quote is about classes, not descriptions, but the point is the same.

it occurs" (see *14.18). But his proofs show that he is *not* "passing outside truth functions" (*14.28; see also *14.3). And so every passage in which he says that, given the existence of $(\exists x)(Gx)$, truth values are unaffected by scope, we should take him as being characteristically careless in omitting the qualification that he put in on page 87: the incompleteness may be relevant when we pass outside truth functions, even when $(\iota x)(Gx)$ exists. [10]

With temporal and causal connectives we do pass outside truth functions; so even within the *Principia* system it is open to us to allow difference of scope to affect truth value, as Smullyan did for modal propositions.

Quine further observes that Smullyan's suggestion involves a fundamental division between proper names and definite descriptions, and Quine admits that, if you accept that division, then examples that show failure of substitutivity must exploit some descriptions rather than just proper names. He goes on to say that this means adopting an "invidious attitude" toward certain ways of specifying something x, e.g., toward "There are just x planets," and favoring others such as

$$x = \sqrt{x} + \sqrt{x} + \sqrt{x} \neq \sqrt{x}$$

as somehow better revealing the "essence" of the object. This is a "reversion to Aristotelian essentialism."

I wouldn't personally regard that as an objection if it were true —but it is surely quite false. For all that is required in the way of invidious attitudes is (a) the assignment of a peculiar role to the proper name, (b) the treatment of some unique descriptions of an object as not *necessarily* satisfied by it. After all the topic was modality! And that treatment is simply the acceptance as true of such a proposition as "Necessarily, $9 = 3^2$."

This point I make not for its own sake, but because it is clarified by the parallel point about causal statements, and showing how this is so may clarify *that* (latter) point. For when we say, "Sure there was a crisis because the man with the biggest nose etc., but not *because* his was the biggest nose" we are adopting an "invidious attitude" toward the description 'man with the biggest nose' and by contrast we probably show favor to the description 'President of the

[10] Russell's meaning for 'extensional function of a function' is different from the sense of 'extensional context' that we have been using—he is interested in the replacement of *predicates* by other coextensive predicates (p. 76, 1st ed.; p. 73, 2d ed.), while we are concerned only with the special case of replacements of *designations* by other designations of the same object—we should not let ourselves be confused by this.

French Republic'. Not, however, because the latter description more nearly reveals the essence of "moi, de Gaulle"; merely because it seems to be true that what he did will have caused a crisis because (among other things) he is President of the French Republic, and not at all because of his having such a big nose. And similarly

$$x = \sqrt{x} + \sqrt{x} + \sqrt{x} \neq \sqrt{x}$$

is favored as a specification G of something in

$$\text{Necessarily } (\imath x)(Gx) > 7$$

and

$$\text{is the number of the planets}$$

is disfavored, merely because giving the one specification seems to result in truth, giving the other in falsehood. "Essence" is not in question in the necessity statement any more than it is in the causal statement. It is probably only because *necessary* properties are often associated with essences that Quine thought you must go in for Aristotelian essentialism to sustain Smullyan's suggestion. But no such suggestion lurks in the offing in connection with causal statements. So it would need to be *shown* that necessity is a concept that presupposes essences.

Reverting, however, to the substantive topic of this paper: note that the proof of truth-functionality given by Quine does not just bear upon causal statements in which two propositions are connected, i.e., causal statements of such a form as:

$$p \text{ because } q$$

The proof concerns *any* context $F(p)$ in which a proposition is embedded. Thus it concerns

$$A \text{ brought it about that } p$$

—whether 'A' is the designation of an event or of a substance, for example, doesn't matter. If this context is extensional, i.e., if designations of the same object in p are intersubstitutable *salva veritate,* then it is truth-functional; i.e., p can be replaced by any proposition of the same truth value. This monstrous consequence shows that we must take the context as intensional, or, adopting Davidson's way out, say that it too "falsifies the logical form of causal statements."

As I have indicated, I find it harmless to say that causal statements are intensional. But our considerations lead to raising the following question: What is at stake in maintaining or denying that an effect is properly described or presented in a *proposition?* I feel that something is at stake—but I don't know what it is. What-

ever it is, in this issue one side is probably correctly represented by the insistence on the proposition; but I suspect—my hunch is—that the other side is the right one, but is *not* correctly represented by objecting to the presentation in a proposition.

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EXTENSIONAL AND NON-TRUTH-FUNCTIONAL CONTEXTS

THERE is a large class of sentences, each sentence s of which contains all the terms of a sentence s'. I shall denote s as $C[s']$, as a "context containing s'," but one must bear well in mind that this notion of containment is not one under which s' has to appear as a unit in $C[s']$, although all the terms of s' must occur as terms of s. I shall let what follows explain the relevant sense of 'contain', although the way the first sentence puts it, it is more dependent than I would want on the accidental features of a language. It is the sense in which 'Milly has a big nose' is contained in 'Milly has a very big nose' or in 'Milly probably has a big nose' (a distinguishing mark, informally, is that you must understand s' to understand s). My intention is to suggest how semantics may be given for a certain subclass of these sentences which satisfy the following three conditions:

(a) Extensionality: if t is obtained from s by substituting predicate B for predicate A, then

$$(x)(A(x) \equiv B(x)) \supset (C[s] \equiv C[t])$$

(b) Referential transparency: If t is obtained from s by substituting a name of b for a name of a, then

$$(a = b) \supset (C[s] \equiv C[t])$$

(c) Non-truth-functionality: we do *not* have

$$(s \equiv t) \supset (C[s] \equiv C[t])$$

nor do we have

$$(x)[(A(x) \equiv B(x)) \supset (C[A(x)] \equiv C[B(x)])]$$

(which may look sufficiently like (a) to cause confusion). I am not assuming that any $C[s]$ can make sense with any s. Most $C[s]$ have evident restrictions, though often (I don't know why) they have intensional variants with weaker restrictions. 'a saw $\cdots$', for example, can contain far fewer sentences than its intensional variant 'a saw that $\cdots$'.

The semantics given will be Fregean in tone: predicates will be represented as functions from individuals to truth values, and truth-