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CONVERSE RELATIONS

Timothy Williamson

Heraclitus said that the way up is the way down. Converse relations (for x to have one to y is for y to have the other to x) are traditionally seen in peculiar intimacy; thus, for instance, Geach:

> a relation neither exists nor can be observed apart from its converse relation; what is more, the concept of a relation and of its converse is one and the same indivisible mental capacity, and we cannot exercise this capacity without actually thinking of both relations together; *relativa sunt simul natura et intellectu.*[1]

This puzzling relation, I shall argue, is, simply but strictly, identity. Though Brutus stabs Caesar, not Caesar Brutus, '- - - stabs ...' and '- - - is stabbed by ...' (and '... stabs - - -') stand for the same relation: to understand '- - - stabs ...' one must know not just which relation it stands for, but which way round its flanking terms are to be fed into that relation. Anything else turns out to involve an unacceptable, irremediable indeterminacy in *which* relation it stands for. Like arguments establish like conclusions for the theory of functions. In itself a curiosity, the point helps our view of universals clear of the shadow of words.

A *relational expression* is a string of words ('- - - stabs ...') with gaps whose replacement by names yields an indicative sentence.[2]

Familiarly, 'Brutus stabs Caesar' is true if and only if Brutus stabs Caesar, 'Caesar stabs Brutus' is true if and only if Caesar stabs Brutus, 'Charlotte Corday stabs Marat' is true if and only if Charlotte Corday stabs Marat. Such facts exhibit common form, crying

[1] *Mental Acts* (London: Routledge, 1957) p. 33. The passage comes from an argument against abstractionism; it could be restated in accordance with the conclusions below.

[2] Some qualifications: a relation is binary unless otherwise specified; its gaps may be subject to category restrictions, e.g., allowing names only of animate objects; they must be transparent—substitutions of codenoting names in them cannot affect the truth value of the relational sentence made by filling the gaps in a relational expression.

out for articulation. Indeed, I *already know* what kind of truth condition the string 'Nod stabs Potter' would have were 'Nod' and 'Potter' names. The concept of names denoting things helps to explain this. I cannot say "'Nod stabs Potter' would be true if and only if Nod were to stab Potter," for 'Nod' and 'Potter' are not actually names, and I talk nonsense if I attempt to use them as such: I can only mention them. I must say that if there were x and y such that 'Nod' denoted x and 'Potter' denoted y, then 'Nod stabs Potter' would be true if and only if x were to stab y. In general, for any names a and b, ⌜a stabs b⌝ is true if and only if what a denotes stabs what b denotes. Since the truth conditions of sentences involving names are not normally sensitive to the existence of linguistic items, names normally denote non-linguistic items: 'Brutus stabs Caesar' is not about language, Brutus and Caesar are non-linguistic (contrast "'neve' translates 'snow'").

Analogously, 'Brutus stabs Caesar' is true if and only if Brutus stabs Caesar, 'Brutus is stabbed by Caesar' is true if and only if Brutus is stabbed by Caesar, 'Brutus is more honorable than Caesar' is true if and only if Brutus is more honorable than Caesar. Such facts exhibit common form, crying out for articulation. Indeed, I *already know* what kind of truth condition the string 'Brutus fifs Caesar' would have were '- - - fifs ...' a relational expression. The concept of relational expressions standing for relations helps to explain this.[3] I cannot say "'Brutus fifs Caesar' would be true if and only if Brutus were to fif Caesar," for '- - - fifs ...' is not actually a relational expression, and I talk nonsense if I attempt to use it as such: I can only mention it. I must say that if there were a relation R such that '- - - fifs ...' stood for R, then 'Brutus fifs Caesar' would be true if and only if Brutus were to have R to Caesar.[4] In general, for any relational expression ⌜- - - R ...⌝, ⌜Brutus R Caesar⌝ is true if and only if Brutus has what ⌜- - - R ...⌝ stands for to Caesar.

[3]This is not to deny all differences between denoting and standing for. Standing for is the nearest to denoting that a relational expression comes; it may not be very near. Note that so far 'relation' means only: what a relational expression could stand for.

[4]A relation like having to, but between things and relational *expressions*, would not suffice, since the truth conditions could then be stated only by reference to a linguistic entity, even for a sentence not about language at all.

Since the truth conditions of sentences involving relational expressions are not normally sensitive to the existence of linguistic items, relational expressions normally stand for non-linguistic items: 'Brutus stabs Caesar' is not about language, the stabbing relation is non-linguistic (contrast "'neve' translates 'snow'").

Generalizing and combining the last two paragraphs: if a and b are names and ⌜- - - R ...⌝ is a relational expression, ⌜a R b⌝ is true if and only if what a denotes has what R stands for to what b denotes. A corollary in non-linguistic terms follows. 'Brutus stabs Caesar' is true if and only if what 'Brutus' denotes has what '- - - stabs ...' stands for to what 'Caesar' denotes. Since 'Brutus' denotes Brutus, '- - - stabs ...' stands for the stabbing relation and 'Caesar' denotes Caesar, what 'Brutus' denotes has what '- - - stabs ...' stands for to what 'Caesar' denotes if and only if Brutus has the stabbing relation to Caesar. Since 'Brutus stabs Caesar' is also true if and only if Brutus stabs Caesar, Brutus stabs Caesar if and only if Brutus has the stabbing relation to Caesar. In general, where 'H(R,x,y)' means that x has R to y, with harmless ambiguity in 'R':

$$Rxy \equiv H(R,x,y) \quad (1)^{5}$$

The second level ternary relation H is simply the counterpart, for first level binary relations, of the second level binary instantiation relation I for first level unary predicates: Brutus stabs if and only if Brutus has the stabbing property; more generally

$$Fx \equiv I(F,x) \qquad (2)$$

Relations such as H and I are notorious provokers of paradox when treated without respect to levels, but the argument will not play on this: first and second level expressions will never appear in the same argument place.

Relations, as they have been introduced, are needed to explain

[5]Henceforth, predicates and relational expressions will precede their arguments in such formulae. Second level predicates and relational expressions are distinguished by an argument list punctuated with commas and brackets. '- - -', '...' and even 'is' will be omitted from quoted relational expressions where convenient.

how relational expressions contribute to the truth conditions of relational sentences in which they appear. This is not to say that they *are* those contributions, any more than what 'Cicero' denotes—Cicero—is the contribution made by 'Cicero' to the truth conditions of 'I didn't realize that Cicero was Tully'. As the way in which a name denotes what it denotes may matter to the truth conditions of containing sentences, so may the way in which a relational expression stands for what it stands for.

Relations are non-linguistic. By this I mean simply that they are not confined to a single mode of representation, not that they are "things in themselves." An English and an Italian word could in principle stand for the same relation; if 'Firenze' denotes what 'Florence' denotes, why should not 'corre' stand for what 'runs' stands for? Relations are at least interlinguistic, at most extralinguistic. This, though implicit in the word 'relation', involves controversial assumptions—such as that 'exact translation' makes some sense and is sometimes in principle possible—which will be defended only indirectly, through elucidation of their consequences.

I assume that every relation R has a converse $\check{R}$. This converse need not, of course, be distinct (the identity relation is its own converse). Many relations have already been seen to have converses: to suppose that some do not would be arbitrary, for what could determine which they were?

Since my argument applies to any n-ary relations "differing" only by a permutation of their arguments, even for $n > 2$, I will understand the identity of converses to assert that such permutations never give a new relation. For simplicity, though, I will state the argument in terms of binary relations.

Why are converses identical? Suppose, for a *reductio ad absurdum,* that some relation R is distinct from its converse. One can think of R as non-symmetric, since if symmetric relations can differ from their converses, non-symmetric ones can *a fortiori.* I assume that R is expressible in language: the position that some ineffable relations, but no others, differ from their converses seems peculiarly void of merit. Moreover, if expressible at all R is expressible in a language using order to distinguish the argument places of relational expressions, and the argument will be stated in these terms: but it could just as well be stated in terms of a reversal of the syntactic forms for nominative and accusative, say. Consider a language L with a relational expression X standing for R: for definiteness, let 'Xab' mean that a stabs b. R itself is not a linguistic entity: writing the stabber's name to the left of the victim's is simply a convention inessential to the nature of R. Even if writing the names in this order somehow mirrored the situation better, this is not the principle on which language works. For instance, in

'The fork is to the left of the knife' (A)

'The fork' *is* to the left of 'the knife'. But that is accidental, for in

'The knife is to the right of the fork' (B)

'The knife' is *not* to the right of 'the fork': yet (B) is not semantically defective compared to (A). Hence a language L′ is possible, exactly like L—in particular, X still stands for R—except for a different convention for X: the stabber's name is to be written to the right of the victim's.[6] Thus the marks ⌜Xab⌝ mean in L′ what the marks ⌜Xba⌝ mean in L: b stabs a. Now a third language L″ is also possible, exactly like L except that X stands not for R but for its converse.[7] Thus the marks ⌜Xab⌝ mean in L″ what the marks ⌜Xba⌝ mean in L: b stabs a—or at least, they are as tightly equivalent as (A) and (B).

L′ and L″ are different languages (dialects?), since in L′ X stands for R while in L″ it stands for $\breve{R}$, and by hypothesis these are different relations. Yet L′ and L″ are indistinguishable: they differ only in respect of X, which is *used* only in contexts where it is followed by its terms, making a whole that functions in L′ just as in L″. Nor can causal affiliations distinguish X in L′ and in L″, for a causal link to a relation runs equally to its converse: of whatever Brutus's stabbing Caesar is cause or effect, so is Caesar's being stabbed by Brutus.[8] Moreover, this distinction without a difference applies to actual languages—if these express relations that differ

[6] If it helps, imagine a similar change for all relational expressions in L.
[7] See previous note.
[8] Brutus's stabbing someone might on some views cause (be caused by) something without Caesar's being stabbed by someone doing (being) so, or *vice versa,* but that is irrelevant: whatever Brutus's stabbing someone causes (is caused by), so does (is) someone's being stabbed by Brutus, and whatever Caesar's being stabbed by someone causes (is caused by), so does (is) someone's stabbing Caesar.

from their converses—not just to the hypothetical L′ and L″. For let E stand to English in respect, say, to 'stabs' just as L stands to L′: then English is indeterminate between E′ and E″.

If relational expressions are indeterminate, so are singular terms purporting to denote relations. For instance, if one spoke of "the relation R such that 'Brutus stabs Caesar' is true if and only if Brutus has R to Caesar," one could not explain how 'Brutus has R to Caesar' had the satisfaction conditions one wanted it to have and not those one wanted 'Caesar has R to Brutus' to have.

Descriptions like 'the relation that Peter is now thinking about' clearly assume that someone else has solved the problem in some other way: such a reference-preserving chain cannot be infinite, nor could it achieve reference if it were. Ostensions like '*this* relation between the knife and the fork' fail, for how could a relation be more salient than its converse? One can notice that the fork is to the left of the plate without noticing that the knife is to the right of the plate: but then one has noticed that the plate is to the right of the fork without noticing that the plate is to the left of the knife—even if the *words* 'the fork is to the left of the plate' come to one more naturally than the words 'the plate is to the right of the fork', any attempt to use that fact to break the symmetry begs the question, by assuming 'left' and 'right' already to be determinately attached to different relations. Again, to notice, of the fork, that it is to the left of the plate is to notice, of the fork, that the plate is to the right of it.

If the denotation of 'the stabbing relation' were stipulated as the set of sets of the form {{x}, {x,y}}, where x stabs y, 'the stabbing relation' and 'the being stabbed relation' would certainly have different denotations, since {{Brutus}, {Brutus, Caesar}} would belong to the former but not to the latter. But such constructions do not tell us what relations are, for what '- - - stabs ...' stands for without need of philosophical stipulation (just as 'Brutus' denotes Brutus without need of philosophical stipulation), is no more closely related to the above set than to the set of sets of the form {{x,y}, {y}}, where x stabs y. In general, if the relational expression ⌜- - -R ...⌝ and its converse ⌜... R - - -⌝ are associated with the logical constructions C and D respectively, they could just as well be associated with D and C respectively. A non-ambiguous relational expression stands for a single relation: by a plausible use of the Principle of

Sufficient Reason, it stands for C if and only if it stands for D; since it cannot stand for both, it stands for neither.[9] In particular, unless 'ϵ' in set theory stood for a relation independently of these constructions, they would not make sense. Relations are what they are and not another kind of thing.

The price of distinguishing converses is that no expression can stand determinately for either of them.[10] We would never know what we were talking about, even if we knew that what we were saying was true. In contrast, if converses are identical no such indeterminacy can arise.

This indeterminacy argument assumes no Quinean behaviorism. Mental images, for instance, even if invoked, could not distinguish R from $\breve{R}$. Rather, the underlying assumption is simply a plausible case of the Principle of Sufficient Reason: English can be like E′ rather than like E″ or like E″ rather than like E′ only if there is something in virtue of which it is so and not otherwise. There are no brute semantic facts.[11]

If we knew of no alternative to distinguishing converses, we might have to accept this indeterminacy. Instead, the identity of converses is a perfectly tenable position, which avoids such indeterminacy. Hence it does better justice to the facts of language: for if a language is indeterminate between two interpretations, each of them is inadequate in discriminating more finely than does the language itself.[12]

Now if all interpretation were in all ways indeterminate, this particular indeterminacy would show nothing special about relations. I cannot here explain why Quine and others do not convince

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[9]Cp. P. Benacerraf, "What Numbers Could Not Be," *The Philosophical Review*, 74 No. 1 (1965), pp. 47–73.

[10]This indeterminacy argument is reminiscent of one used by Putnam against realism, to the effect that the truth conditions of sentences do not determine the references of terms: but whereas he dismisses causal considerations as irrelevant in principle by illicit appeal to the supposed indeterminacy of 'cause' in the meta-language I accept them as relevant in principle but useless in this particular case: cf. *Reason, Truth and History* (Cambridge: The University Press, 1981), Chapter 2.

[11]That is to say that semantic facts *supervene* on something else, not that they *reduce* to it.

[12]Cf. John McDowell's conclusion to "Truth Conditions, Bivalence, and Verificationism," in Evans and McDowell (eds.), *Truth and Meaning* (Oxford: The University Press, 1976).

me;[13] however, the indeterminacies for which they have argued are quite different from those now at issue. Quine's rival interpretations of 'gavagai', for instance, are "external" to each other: they involve concepts whose instances are different kinds of thing (rabbits, rabbit-parts, rabbithood). In contrast, my rival interpretations are "internal" to each other: converse relations have the same terms. Thus if one interprets a token of 'gavagai' as denoting a rabbit, elementary causal considerations usually determine *which* rabbit it denotes: talk of rabbits is internally determinate. But the indeterminacy in 'before' occurs *after* one has decided to interpret it as standing for a relation, for nothing determines *which* relation it stands for: talk of relations would be internally indeterminate. If nothing ever determined which rabbit if any we were talking about, something *would* be wrong with talk of rabbits. Likewise, if nothing ever determined which relation if any we were talking about, something would be wrong with talk of relations. Since nothing is wrong with talk of relations, relational expressions are not indeterminate between converses; so converses are identical.

The identity of converses sounds absurd, for it seems to entail that all relations are symmetric. Indeed, given the defining equivalence for 'H' it does so. For substituting '$\breve{R}$' for 'R' in (1):

$$\breve{R}xy \equiv H(\breve{R},x,y) \qquad (3)$$

If $R = \breve{R}$

$$H(R,x,y) \equiv H(\breve{R},x,y) \qquad (4)$$

From (1), (3) and (4):

$$Rxy \equiv \breve{R}xy \qquad (5)$$

That is,

$$Rxy \equiv Ryx, \qquad (6)$$

[13] But cf. Gareth Evans, "Identity and Predication," *Journal of Philosophy* 72 (1975), pp. 343–363.

which is absurd, since R was arbitrary. Since 1981 is before 1982, it is not after 1982: how can before and after be one? 1981 has one and not the other to 1982. However, this objection carries no weight. Given the identity of converses, 'H' is obviously ill-defined, for nothing in 'H(R,x,y)' shows which way round x and y are to fill R's gaps. The above derivation merely dramatizes this fact.

Note an ambiguity in the notation: 'R' has been used both as a singular term denoting a relation and as a relational expression standing for a relation. $R = \breve{R}$ allows the substitution of '$\breve{R}$' for 'R' only in contexts where they are singular terms. Thus one cannot argue from '$Rxy \equiv Rxy$' to '$\breve{R}xy \equiv Rxy$', since in 'Rxy', 'R' is a relational expression. Although it stands for the relation R, this does not exhaust its semantic significance: it stands for R *with a particular convention as to which flanking name corresponds to which gap in R*. Since '$\breve{R}$' as a relational expression uses the opposite convention, the substitution of '$\breve{R}$' for 'R' in contexts where they are relational expressions cannot be expected to preserve truth value. Henceforth, $\ulcorner r x_1 \ldots x_n P \urcorner$ will denote the n-ary relation in which the open sentence P with 'x_1',...,'x_n' as free variables places $x_1,\ldots,x_n$. For convenience, however, I denote ruvRuv by 'R' when no dangerous ambiguity results.

Why should 'before' and 'after' not stand for the same relation R? The proposition that a is before b is the proposition that b is after a: if the before relation results from dropping a and b from the former, the after relation from dropping them from the latter and the propositions are the same, so are the relations. R has two argument places, one for the term said to be (whether or not it really is) before, the other for the term said to be after. For simplicity, I speak of putting the entities which R is said to relate themselves into these argument places, but nothing would be jeopardized if individual concepts of them, for instance, were strictly what filled the gaps. Now if relational sentences are of the form 'aRb', where 'R' stands for the relation and 'a' and 'b' for its terms, there are clearly two possible conventions for representing the result of filling the gaps in R. The lefthand name could denote what fills the "before" place and the righthand name what fills the "after" place, or the lefthand name could denote what fills the "after" place and the righthand name what fills the "before" place. 'Is before' as a value of 'R' uses the former convention, 'is after' the latter. Thus the nature of a single relation, which is equally "before" and "after," explains the appearance of distinct, converse relations in language. So although 'before' and 'after' stand for the same relation, 'a is before b' and 'a is after b' express different propositions: hence no paradox results.

The identity of converses demands a rethinking of the application of logical operators to relations, though this does not seem to threaten any laws of classical logic. Conjunction, for instance, is normally assumed to apply to relations: one writes

$$\text{rxyRxy} \ \& \ \text{rxySxy} = \text{df rxy(Rxy} \ \& \ \text{Sxy)} \qquad (7)$$

in blithe confidence that the ambiguity in '&' is harmless. Surely the right-hand relation exists—how else is such a proposition as $\forall x \exists y(Rxy \ \& \ Sxy)$ to be analyzed?[14]—and the lefthand is in effect its analysis into component relations. Given the identity of converses, such definitions are no longer possible. For let rxy(Rxy & Sxy) be *any* function * of rxyRxy and of rxySxy:

$$\text{rxy(Rxy} \ \& \ \text{Sxy)} = \text{rxyRxy} * \text{rxySxy} \qquad (8)$$

By the same token:

$$\text{rxy(Rxy} \ \& \ \text{Syx)} = \text{rxyRxy} * \text{rxySyx} \qquad (9)$$

But by the identity of converses:

$$\text{rxySxy} = \text{rxySyx} \qquad (10)$$

Since * is a function, (9) and (10) give:

$$\text{rxy(Rxy} \ \& \ \text{Syx)} = \text{rxyRxy} * \text{rxySxy} \qquad (11)$$

Hence from (8) and (11):

$$\text{rxy(Rxy} \ \& \ \text{Sxy)} = \text{rxy(Rxy} \ \& \ \text{Syx)} \qquad (12)$$

[14] I assume that *we* cannot understand such sentences as infinite disjunctions.

(12) implies that 'stabs and kills' stands for the same relation as 'stabs and is killed by'. But rxy(Rxy & Syx) is not the converse of rxy(Rxy & Sxy) (rxy(Ryx & Syx) is). The latter is not even a function of the former.[15] The rationale for the identity of converses certainly does not extend so far. Indeed, (12) threatens the very possibility of explaining the truth conditions of conjunctive relational sentences: this perhaps could be done if the conjunct relations could be recovered from their conjunction[16] and treated separately, but then why postulate the conjunction? No conjunctive operation that does more than list its arguments and pair them with a marker for conjunction is well defined on relations. A corresponding conclusion can be reached for all other non-trivially binary (or n-ary, for $n>2$) truth functions.

This conclusion is more natural than it sounds. Imagine a system for carrying relational messages of two kinds. Those of the first kind are expressed by a box containing a red bag and a green bag containing symbols for the respective terms of the first relation. Those of the second kind are expressed by a box containing a blue bag and a yellow bag containing symbols for the respective terms of the second relation. Several boxes taken together form a conjunctive message. A box containing empty red and green, or blue and yellow, bags seems to correspond to a relational expression such as 'stabs' or 'kills', taken without its arguments. Presumably, then, a box containing empty red and green bags taken together with a box containing empty blue and yellow bags corresponds to the conjunctive relational expression 'stabs and kills', taken without its arguments. Thus the pair of boxes too must stand for a binary relation: but should the symbol that goes into the red bag go into the yellow or into the blue? The question has no answer, yet the system seems adequate for carrying relational messages.

The illusion that relations have well-defined conjunctions is

[15]Let $\leqslant$ be the usual order on the natural numbers. Define 'Rxy' as $x \leqslant y$, 'Sxy' as $y \leqslant x$ and 'S′ xy' as $x=y$. Then rxy (Rxy & Sxy) and rxy(Rxy & S′xy) are logically equivalent (to identity), as is rxy(Rxy & S′yx), but rxy(Rxy & Syx) is logically equivalent to rxyRxy. (12) implies that rxy($x=y$) and rxy($x \leqslant y$) are, up to logical equivalence, the same relation on the natural numbers.

[16]This presupposes something like intensional isomorphism as the criterion of identity for relations.

based on the fact that the arguments of relational expressions in natural language are distinguished in a *uniform* way. In English, one term is always written to the left of (or above) the other, or spoken before; inflexional languages use, for instance, the distinction between the nominative and accusative cases.[17] Logically this is irrelevant. Given the identity of converses, not only are the argument places of relations not intrinsically 'first' and 'second': they do not even naturally correspond from one relation to another in such a way that, although calling one argument place rather than the other of a given relation 'first' would be arbitrary, calling the corresponding argument place of another relation 'first' would be a non-arbitrary consequence of this decision. Argument places in different relations can be associated only in terms of the content of the relations: one can non-arbitrarily associate the argument place occupied by Brutus in the proposition that Brutus stabs Caesar with that occupied by Oswald in the proposition that Oswald shot Kennedy, but which argument place do they correspond to in the proposition that Brutus is unlike Oswald? These associations have no systematic significance for the theory of relations. As so often in philosophy, a feature of the form of representation has been taken for a feature of what is represented.

Two binary relations can be conjoined in two ways to form (generally) two conjunctive binary relations:[18] rxy(Rxy & Sxy) (= rxy(Ryx & Syx)) and rxy(Rxy & Syx) (= rxy(Ryx & Sxy)). Although the conjuncts do not determine the conjunction, they can be considered as its constituents, just as the same constituents may be put together in different ways to make different sculptures—which may nevertheless share a common form.

Nor does the denial that conjunction is well-defined for relations imply that we do not "understand a whole by understanding its parts and the way in which they are put together." Consider a sentence such as $\forall x \exists y$(Rxy & Sxy). To understand 'Rxy' and 'Sxy' separately one needs to know, not just which relations they stand for, but which of the latter's argument places 'x' is associated with and which 'y': this resolves the "ambiguity" between rxy(Rxy &

[17]Cf. P. T. Geach, "Names and Identity," in S. Guttenplan (ed.) *Mind and Language* (Oxford: The University Press, 1975), p. 148.

[18]The quaternary relation rwxyz(Rwx & Syz) could also be considered as formed out of rxyRxy and rxySxy.

Sxy) and rxy(Rxy & Syx): one knows in which way R and S are to be put together. The lesson is that understanding a relational expression is not simply associating it with a relation, but knowing in which way it is to be associated.[19]

Similar remarks apply to second-order binary relations between relations as to second-order operations on relations. For instance, entailment is not well-defined on relations: if x is an hour before y, it is before y and so not after y; since 'before' and 'after' stand for the same relation, it is in itself neither a consequence nor a contrary of that for which 'an hour before' stands. But this does not matter, since entailment *is* (I assume) well-defined on propositions. In contrast, the identity of converses has less impact on unary operations and on properties of relations. Negation is well-defined on relations, as are most of the properties in terms of which relations are classified: transitivity, intransitivity, symmetry, asymmetry, antisymmetry, reflexivity, irreflexivity, connectedness.[20] A theory of relations in such absolute terms would be interesting.

As indicated above, the argument for the identity of converses extends naturally from binary to n-ary relations, for n>2. Essentially, it exploits the possibility of producing 'Rba' from 'Rab' by permuting 'a' and 'b'. Hence it can be applied to any of the n!-1 non-trivial permutations of the argument places of an n-ary relational expression. For instance, the following six formulae, none of them equivalent, stand for the same relation between x, y and z: x is nearer to y than to z; x is nearer to z than to y; y is nearer to x than to z; y is nearer to z than to x; z is nearer to x than to y; z is nearer to y than to x. The argument also applies to all functions of at least two arguments: 'x−y' and 'y−x' stand for the same function of x and y—and this no more implies that $3-4 = 4-3$ than the identity

[19]That associating an expression with a relation is not like associating it with a smell, and that the phrase *describes* rather than explains understanding should go without saying.

[20]Transitivity is well-defined because $\forall x\forall y\forall z(Rxy\rightarrow(Ryz\rightarrow Rxz))$ trivially entails $\forall x\forall y\forall z(Ryx\rightarrow(Rzy\rightarrow Rzx))$. In contrast, $\forall x\forall y(Rxy\rightarrow Rxx)$ does not express a well-defined property of relations, since it does not entail $\forall x\forall y(Ryx\rightarrow Rxx)$ (let 'Rxy' mean that x is a dog). Many-oneness is also not a well-defined property of relations, like most features associated with functions taken as relations, since one argument must be chosen as the value of the function; many-oneness may be viewed as a second order relation between a first order relation and one of its argument places.

of the relations for which 'before' and 'after' stand implies that 1982 is before 1981. $3-4$ and $4-3$ result from filling the two gaps in one function, which can be written both as $\lambda xy(x-y)$ and as $\lambda xy(y-x)$, in two different ways. Similarly for higher order connectives of at least two arguments: any conditional and its converse are identical, with the usual explanation of why this does not imply that '$P \rightarrow Q$' and '$Q \rightarrow P$' are equivalent.

The question of unary functions is more delicate. Often, unary functions are identified with many-one binary relations. The identity of converses supports a variant of this identification, where 'many-one or one-many' replaces 'many-one', which becomes ill-defined. For if $rxy(f(x) = y)$ and $rxy(f(y) = x)$ are distinct, why should f be identified with one rather than the other? Hence anyone who takes functional expressions to stand for functions independently of these being subsumed as relations should deny that functions are relations at all, if converses differ. In contrast, if $rxy(f(x) = y) = rxy(f(y) = x)$, their identification with f is wholly natural. The identity of converses would then imply the identity of unary functions with their inverses, when they have them; again, this would not imply that $4+3 = 4\text{-}3$.

The identity of converses suggests a larger project, of explaining the diversity of linguistic forms from a tighter system of non-linguistic entities whose nature allows them to be represented in diverse ways. Of course, the existence of synonyms has always been a rationale for postulating universals, but I suggest that this unification can be taken much further. Realism about universals sometimes looks like the implausible projection of linguistic forms onto a misty beyond. For it merely to insist that universals and words are quite differently structured, without explaining how, is no help. I hope in this paper to have suggested how such vague ideas as that language is linear and thought is not—often encountered at parties as a reproof for philosophers—might lead to a rigorous programme for identifying and eliminating the illicit influence of linguistic structures on our theory of universals.[21]

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