previously observed (call this "Y"). Yet what I now observe can be both exactly similar to and in the same location as what I previously observed, even though the two things are numerically different. Therefore the expression 'X is numerically different from Y' cannot *mean* "X and Y occupy different locations," unless the expression 'numerically different' is equivocal, that is, unless it has one meaning in the first sort of situation and a different meaning in the second sort of situation.

What this objection shows is that we must add to the expression which renders the meaning of 'numerically different': "Two objects are numerically different (a) if they coexist, then when and only when they occupy different locations, or (b) in case they in fact never coexist, if and only if they would have occupied different locations had they coexisted." But to make the addition represented by part (b) is only to add further specification concerning the locations of bodies. It is not to mention something unobservable which is said to be contained within material objects. It seems, then, that a substratum or bare particulars need not be postulated if the expression 'numerical difference' has the meaning suggested above. But if it has the suggested meaning, then relations do individuate. For then X and Y are numerically different when and only when they have or would have had different locations, that is, when and only when they have or would have had different spatial relations to other bodies.

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NOTES

[1] E. B. Allaire, "Another Look at Bare Particulars," *Philosophical Studies*, 16:19 (1965).
[2] *Ibid.*, p. 18.
[3] *Ibid.*, p. 19.
[4] *Ibid.*

Scriven on Human Unpredictability

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IN HIS paper "An Essential Unpredictability in Human Behavior,"[1] Michael Scriven offers an argument intended to show that it is impossible in principle to predict what a person (or indeed a suitable robot) will do in a certain

possible kind of situation. Moreover, this unpredictability is independent of any indeterminism in physics, of any limitations on the predictor's knowledge of data and laws, and of any limitations on the reliability or amount of calculation the predictor can do. Scriven's argument is a purported proof that if a person in the designated situation is predicted, even by a predictor who does as well as is in principle possible, the prediction will turn out false.

We shall show that Scriven's argument depends on a hidden premise which we have no reason to accept. Without the hidden premise, Scriven cannot demonstrate any failure of prediction which we cannot explain away as due to limitations, in principle remediable, on the amount of calculation available to a given predictor. We conclude that Scriven's argument does not establish an essential unpredictability in human behavior in any interesting sense. Rather it is a *reductio* establishing the falsehood of Scriven's hidden premise.

Scriven's Argument

Let us imagine somebody who is trying to predict the outcome of a free[2] choice by somebody else who is dominantly motivated to avoid being validly predicted. (The *dramatis personae* are called, respectively, the *predictor* and the *avoider*.) Perhaps the avoider has been put in a position where he stands to lose if the predictor knows in advance what he will choose; or perhaps he is just averse to being predicted. Either way, if the avoider learns in time what he is predicted to do, he will do something else, so the prediction will turn out false. If, for instance, the predictor announces the prediction to the avoider, the avoider chooses contrary to the prediction. But the avoider may be able to find out the prediction without being told it by the predictor. If the avoider has enough knowledge of data and laws and can do enough calculation with high reliability, he can duplicate the predictor's calculation to find out what result it gave. In this case also he will do something else (being *ex hypothesi* free and motivated to do so), so the prediction will turn out false.[3]

Therefore Scriven maintains that if the avoider has a free choice, and if he is dominantly motivated to avoid being validly predicted, and if he uses the stratagem of duplicating and violating predictions, and if he has enough knowledge of data and laws, and if he can do predictive calculations reliably, and if he can do enough calculation (within whatever are the prevailing constraints imposed by limited computing speed, limited memory capacity, deadlines, and eventual discouragement, fatigue, or death), then it is in principle impossible to predict his choice. No matter how perfect is the predictor's knowledge of data and laws, no matter how reliably the pre-

dictor can calculate, no matter how much calculation the predictor can do, no matter how the predictor has tried to compensate for the fact that the avoider is working to duplicate and violate his prediction,[4] still if the predictor somehow reaches a prediction, the avoider will duplicate and violate it and it will turn out false.

The Compatibility Premise

The predictor's failure is significant only if the predictor can do his task as well as it is in principle possible to do it. Otherwise Scriven's demonstration that the predictor fails does not establish that the avoider's choice is unpredictable in principle; it just shows that *this* predictor hasn't got what it takes to predict this avoider. The predictor must therefore have perfect knowledge of data and laws, must be able to do predictive calculation with perfect reliability, and must be able to do enough calculation. Scriven does not, unfortunately, state this set of conditions; but they are indispensable to his argument.

The avoider must have as much knowledge of data and laws as the predictor, must also be able to do predictive calculation with perfect reliability, and must also be able to do enough calculation. Scriven does explicitly stipulate this set of conditions.[5] Without them he could not prove to us that the avoider succeeds in duplicating the predictor's calculation, and so could not prove that any resulting prediction turns out false. Since Scriven is trying to prove only an existence theorem—that there exists *some* possible situation in which choice is in principle unpredictable—he is entitled to endow the avoider with whatever possible abilities the argument may require.

Since Scriven is apparently not fully aware that his argument uses the first set of conditions as well as the second, it never occurs to him that it may be impossible for any predictor and avoider to meet both sets at once. They may both have perfect knowledge and calculate with perfect reliability; but it is not necessarily possible even in principle for them both to be able to do enough calculation. For the amount of calculation required to let the predictor finish his prediction depends on the amount of calculation done by the avoider, and the amount required to let the avoider finish duplicating the predictor's calculation depends on the amount done by the predictor. Scriven takes for granted that the two requirement-functions are *compatible*: i.e., that there is some pair of amounts of calculation available to the predictor and the avoider such that each has enough to finish, given the amount the other has.

The compatibility of the two requirement-functions is an implicit premise of Scriven's argument, although there is no indication that Scriven is aware of using it. For without it the argument cannot be made to work: unless

the predictor can do enough calculation his failure is insignificant; unless the avoider can do enough the failure cannot be shown to occur at all; only by the Compatibility Premise can both insufficiencies be ruled out at once.

We can find no reason whatsoever to accept the Compatibility Premise. The very fact that it yields Scriven's thesis of essential unpredictability looks to us like a convincing reason to reject it.

Figure 1: COMPATIBILITY PREMISE TRUE

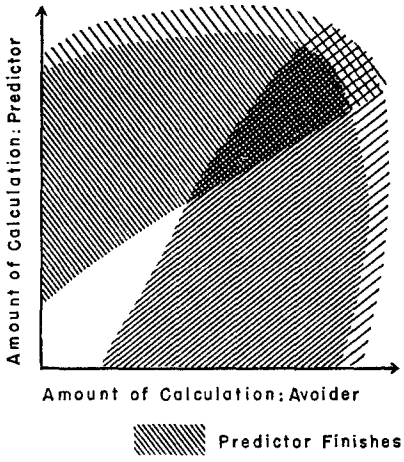
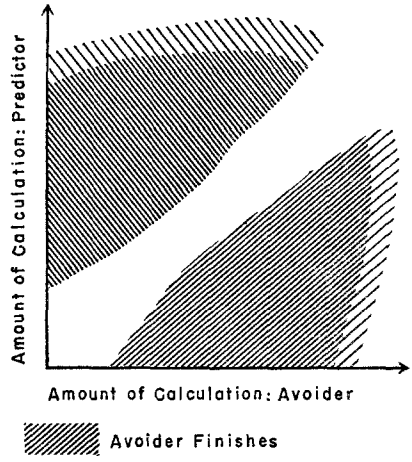


Figure 2: COMPATIBILITY PREMISE FALSE



Figures 1 and 2 represent cases in which the Compatibility Premise is, respectively, true and false. The vertical and horizontal coordinates of any point represent a pair of amounts of calculation available to the predictor and the avoider. Under the Compatibility Premise (Figure 1) there is an area (the upper right) in which both the predictor and the avoider can finish their calculations. Under our rejection of the Compatibility Premise (Figure 2) there are no such points; everywhere one or both fail to finish.[6] If the predictor finishes and the avoider does not, the avoider has no chance to learn the prediction and do something contrary to it, so the predictor succeeds. If the predictor does not finish, he has no valid prediction and is reduced to blind guessing, so the avoider succeeds. (If the predictor does not finish and the avoider does not duplicate his guess, then it's guess against guess. The predictor may succeed at guessing after he has failed at predicting.)

The Compatibility Premise is easily hidden by ambiguity in ordinary language. It is true that against any *given* avoider the predictor can in principle do enough calculation to finish; it follows (unless the Compatibility Premise

is true) that any possible avoider is in principle predictable. It is likewise true that against any *given* predictor the avoider can in principle do enough to finish; it follows (barring a lucky guess by the predictor which the avoider does not duplicate) that any predictor is in principle avoidable.[7] But to say that *both* can in principle do enough to finish is ambiguous. It may be read as the conjunction of the two innocent statements above; or it may be read as the Compatibility Premise, i.e., as stating that against *each other* both can do enough to finish. We must see that we do not accept the Compatibility Premise inadvertently by slipping from the first reading to the second.

A Variant of Scriven's Argument

So far we have supposed that Scriven must stipulate just how much calculation the predictor and avoider can do. Now suppose Scriven stipulates instead that the avoider is unlimited: he can do any amount of calculation he needs, postponing his choice until he has finished.[8] He will never have to make his choice until after he has either duplicated the prediction or found out that the predictor cannot finish. This unlimited avoider would indeed be unpredictable in principle, independently of the Compatibility Premise. For even if the Compatibility Premise is false, in which case the predictor fails only because he cannot do enough calculation, yet under the new stipulation the cause of the predictor's failure is no longer remediable in principle since *no* (finite) amount of calculation would be enough against an unlimited avoider. The unlimited avoider can impose a variable requirement for calculation on the predictor confronting him, which depends on and always exceeds the predictor's own capability.

But if Scriven chooses to posit an unlimited avoider in order to rescue his argument from depending on the Compatibility Premise, he only substitutes one unacceptable premise for another. We grant that an avoider may in principle have any limit, no matter how high; but we do not grant that he may in principle have no limit at all. For we can show that, unless the Compatibility Premise is true after all, an unlimited avoider must not only be able to do any amount of calculation but also must be able to do *endless* calculation. (Consider that if the avoider can be unlimited, so can the predictor. If both are unlimited neither stops until finished. If one finishes and stops the other can eventually also finish. If both finish the Compatibility Premise is true after all. So neither ever stops.) But we certainly do not grant that endless calculation is possible even in principle.

We conclude that neither version of Scriven's argument succeeds in establishing his thesis of an essential unpredictability in human behavior.

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NOTES

[1] In *Scientific Psychology: Principles and Approaches*, edited by Benjamin B. Wolman and Ernest Nagel (New York: Basic Books, 1964), pp. 411–25. Scriven has summarized his argument elsewhere: part of "The Frontiers of Psychology: Psychoanalysis and Parapsychology," in *Frontiers of Science and Philosophy*, edited by Robert G. Colodny (Pittsburgh: University of Pittsburgh Press, 1963), pp. 120–27; and part of "The Limits of Physical Explanation," in *Philosophy of Science: The Delaware Seminar*, II, edited by Bernard Baumrin (New York: Wiley, 1963), pp. 126–30.

[2] Free, that is, in some ordinary sense which is neutral as to predictability. To stipulate "contra-causal" freedom would obviously beg the question.

[3] The contra-predictive stratagem of duplicating and violating the prediction is entirely independent of another contra-predictive stratagem discussed by Scriven, the "mixed strategy" of game theory: the avoider can decide to let his choice be governed by the least predictable system available, say a quantum randomizer. The stratagem of duplicating and violating the prediction is supposed to render the avoider unpredictable regardless of any other source of unpredictability (such as indeterminism in quantum physics). Use of mixed strategy can make the avoider as unpredictable as anything else, but no more; so it does not suffice to support Scriven's main thesis.

[4] A frequent first response to Scriven's argument is as follows: the predictor should make a prediction and then reverse it to get the correct prediction. But that response betrays a failure to appreciate the generality of Scriven's argument. No matter what twists and turns the predictor goes through on his way—let him reverse himself, let him reverse himself again, let him reverse himself any number of times, let him reflect on his sequence of reversals and transcend it—if a final prediction is ever forthcoming, it is that *final* prediction which is duplicated and violated.

[5] "An Essential Unpredictability in Human Behavior," p. 415.

[6] Cf. Lewis F. Richardson's analysis, in *Arms and Insecurity* (Pittsburgh: Boxwood, 1960), of interdependent national requirements for armament. The truth of the Compatibility Premise corresponds to the existence of pairs of armament-levels which are stable because mutually satisfactory.

[7] We accept Scriven's line of argument without the Compatibility Premise so far as it shows only that for any possible predictor there is some possible avoider such that prediction is impossible. But Scriven clearly wants the stronger conclusion that there is some possible avoider such that for any possible predictor prediction is impossible; and to reach that conclusion he must use the Compatibility Premise.

[8] Scriven's statement (p. 415) that the avoider is subject to a deadline would, if adhered to, allow an unlimited avoider only if he were unlimited in speed rather than in time.

Assertion and Belief

by CHARLES SAYWARD

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IN SOME recent discussions of Moore's paradox, it has been alleged that one can use a sentence of the form "*p*, but I believe not-*p*" to make an assertion. For example, in a paper appearing in this journal, Lennart Åqvist[1] states