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CONTEXTUALISM, MECHANISM AND THE CONCEPTUAL ANALYSIS
OF THE CAUSAL RELATION

Ullin T. Place

University of Wales Bangor.

Abstract

The notion that *mechanism* and *contextualism* are two alternative and conflicting ways of conducting the scientific enterprise rests on a misunderstanding of the nature of the causal relation. Every effect is the outcome of *many* causes. Where the effect is an event, there is always a single *triggering event* which combines with a set of *standing conditions* which are already in place to complete the set of causes which are jointly sufficient for the coming about of the effect. In a *mechanism*, one triggering event leads inevitably to another because any variation in the standing conditions has been eliminated by strict control of the *context* within which the causal process takes place. Most mechanisms are a product of human artifice. Some, such as the movements involved in animal locomotion, are the product of natural selection. Another example of mechanical causation in biology is the transmission of excitation across the synapse from the pre-synaptic to the post-synaptic neuron. However, research by connectionists on the properties of artificial neural networks shows that mechanical causation at the neuro-synaptic ('molecular') level yields multi-factorial contextual causation at the ('molar') level of the network as a whole.

The Contextualism/Mechanism debate rests on conceptual confusion

In this paper I argue that the contrast which Stephen Pepper (1942) draws in his book *World Hypotheses* between contextualism and mechanism and his contention that they constitute two alternative and conflicting world views, each with its own scientific methodology between which we are forced to choose, is based on a conceptual confusion, a confusion concerning the nature of the causal relation.

Causation as a relation between situations

In order to defend that claim I need to explain what I take to be the correct way of understanding the causal relation. The first point to be made in giving such an account is that the relation between cause and effect is a relation between what Barwise and Perry (1983) call "*situations*". Situations in their sense are of two kinds, *events* and *states of affairs*. An event consists in a change in the properties of entity or in the relations between two or more entities. Such changes can occur either instantaneously, as when something starts or stops, or spread over a period of time in which case we speak of a *process* or *activity* going on. A state of affairs is a situation in which some property of an entity or relation between two or more entities persists unchanged over a period of time. You will note that the three terms of a contingency are situations in this sense. The antecedent conditions may consist in a state of affairs such as a state of food deprivation or a conditional discriminative stimulus, such as light which has been on for some time before another discriminative stimulus which triggers the response appears. The stimulus which triggers the response, on the other hand, is an event, as is the behavior that it triggers. The emergence of the consequence is also an event, but what is often more important for its effect on behavior is the state of affairs that is thereby brought into existence.

A contingency of course, involves three causal relations, or perhaps we should say, three sets of causal relations. One causal relation is between the antecedents and the behavior emitted under those conditions. A second is that between the behavior emitted and its consequences. While the third is that between the experience of the contingency as a whole and its effect on the probability of the organism's repeating the same behavior on a subsequent occasion. Not all such relations of course, are causal relations. For example, in the case of what Skinner calls "superstitious behavior" there is no causal connection between the "superstitious" aspect of a response and its reinforcing consequence.

The causal counterfactual and the laws that support it

What are we saying when we say of a sequence of events that in one case the two events are causally dependent, while in another case they are causally independent and follow one another only "accidentally" as the saying goes? The answer seems to be that in the genuinely causal case, *if the cause had not existed or*

occurred, the effect would not have existed or occurred, whereas, in the accidental case, the second event would still have occurred, if the first event had not, or in the case of a state of affairs, would have continued to exist, even if its supposed cause were to be or to have been removed. This is the so-called "*causal counterfactual*" which is problematic for a number of reasons, but particularly because we can never observe what would have happened if things were different from the way they actually were. Consequently, the only way to establish the truth of such a claim is to deduce from a universal law statement of the form:

If at any time a state of affairs or event of the cause type were to exist or occur, *and all other causally relevant factors are in place*, the probability that a state of affairs of the effect type would exist or occur, would substantially increase.

It is often supposed, particularly by philosophers, that such universal law statements have to be "laws of nature" in the sense of universal principles, like the laws of physics, which apply everywhere in the universe. In fact, as the American philosopher, Nelson Goodman (1955/1965) points out in his book *Fact, Fiction and Forecast*, all you need to "sustain" a causal counterfactual is a statement ascribing what may be only a temporary dispositional property to the entity or entities involved in the causal interaction. Thus we can say that the glass was so brittle that it broke when lightly touched by a hammer, meaning by that had it not been so brittle that touch of the hammer would not have been enough. In such cases we are appealing not to a universal law of nature, but to an individual law of the nature of that particular object or rather of that object's interaction with other things such as heavy metal objects. Needless to say, causal explanations which depend on temporary response probabilities based on the previous reinforcement history of a particular individual are the most common form of explanation in behavior analysis. They give behavior analysis its distinctive character.

Causes are always multiple

However, for our present purpose what I particularly want to emphasize about the form of universal law statement required to support a causal counterfactual, as stated above, is the so-called *ceteris paribus* or 'other things being equal' clause which I have put in italics. The same prejudice in favor of the universal which makes logicians and philosophers of science insist on universal laws of nature quantified over all

entities of a kind, rather than just occasions, so long as a particular disposition persists, also leads them to regard these *ceteris paribus* clauses as an imperfection which a genuinely scientific causal explanation would eliminate. This to my mind is a mistake. The *ceteris paribus* clause simply reflects the fact that for any particular effect there are always multiple causes which jointly contribute to its existence or occurrence. In other words, the popular notion which affects many philosophical accounts of causation according to which many, if not all effects have a single cause is very wide of the mark - a reflection of the phenomenon charted by Nate Azrin and his colleagues at Anna State Hospital in the 1960's (Ulrich and Azrin 1962, Azrin, Hutchinson and Sallery 1964, Azrin, Hutchinson and Hake 1966), whereby under conditions of frustration or inescapable aversive stimulation an organism "needs" a single and suitably destructible target object which it can "blame" for its misfortune.

Synchronous and sequential multiplicity

However, this multiplicity of causal factors is of two kinds which, I shall call *synchronous multiplicity* and *sequential multiplicity* respectively. I shall argue that the belief that contextualism and mechanism are somehow opposed to one another arises from a failure to recognize that a mechanism is simply a causal sequence which is repeated over and over again because variation due to the synchronous causes emphasized by the contextualist has been artificially restricted.

Synchronous multiplicity

The multiple synchronous causes emphasized by the contextualist are those which must all be present so long as a state of affairs persists or at the moment when an event begins to occur. Where the effect is a state of affairs all such causes must be states of affairs which persist so long as the effect persists. If any of those causal states ceases to exist, the effect will cease to exist. Think of the keystone of an arch whose removal will cause the arch to collapse. Where the effect is an event, all but one of the causes will be states of affairs which have already been in position for some time before the effect occurs. In this case, the effect is *triggered* by a single event which combines with the *standing conditions* which make up the context in which the effect occurs so as to complete the set of causal conditions which are jointly *sufficient* for the coming about of the

effect. This single triggering event is part of what gives plausibility to the notion that, in cases where the effect is an event, there is just a single cause. However, in terms of its contribution to the coming about of the effect, the triggering event is often relatively insignificant in comparison to the standing conditions. Think of the climber's shout which triggers the avalanche.

Synchronous multiplicity and the experimental method

It is because of the multiplicity of these synchronous causes that the only way to establish the nature of the causal laws, whether individual or universal, which are needed to support the various causal counterfactuals contained in our causal judgments is what John Stuart Mill (1843) called "the method of concomitant variation" or the EXPERIMENTAL METHOD in which each of the various elements in a typical cause and effect situation are varied systematically while keeping all other factors constant. Only when all the possible relevant factors have been systematically and independently varied in this way does it become possible to replace the *ceteris paribus* clause in a causal law statement with an accurate specification of all the other contributing causes and the nature of their contribution.

Sequential multiplicity: the causal chain

I use the expression "multiple sequential causes" to refer to the phenomenon whereby every effect, whether it be a state of affairs or an event, stands at the end of a sequence of events and intervening states of affairs which in principle, though not of course in practice, can be traced back, as we now know, to the beginning of time with the so-called "big-bang". However, we also now know that the idea, promoted by my near namesake, Laplace, that everything that has happened subsequently could have been predicted by a supreme intelligence who knew all the laws of nature involved, is not true; and the reason why it is not true, is because of the multiplicity of *synchronous* causes at each step in the causal chain. To illustrate this point, think of any sequence of historical events such as those linking the assassination of the Archduke Franz Ferdinand in Sarajevo in August 1914 to the declaration of war by the United States three years later, or the sequence of events leading up to and into the present conflict in the former Yugoslavia.

Mechanism

This brings us finally to the phenomenon of mechanism. A mechanism is a sequence of events in which one triggering event leads to another in a predictable manner, typically in the form of a repeating cycle, such as those which maintain an engine in motion. Such predictable sequences can only be achieved by preventing changes from occurring in the standing conditions in such a way that what happens is completely determined by each triggering event as it occurs. Most such sequences that we encounter are arranged by human artifice, but there are also many examples of biological processes, particularly at the physiological and biochemical level, which proceed, thank goodness, in this mechanical fashion. In this case, control over variations in the standing conditions required to keep the mechanism working is brought about by the process of variation and natural selection, rather than human artifice.

Mechanism in the nervous system and the brain

We owe the idea that the behavior of living organisms is controlled in this mechanical way at the molar level to Descartes who was influenced in this by the ingenious mechanical robots which were being constructed in his day to provide entertainment and, doubtless prestige, for noble patrons. But this idea would never have achieved the acceptance it did, were it not for the fact that it was specifically restricted by Descartes to the behavior of animals and, in the human case, to what became known as "reflexes". In humans, according to Descartes, the mechanical reflex arc is interrupted by the intervention of the essentially non-mechanical, non-physical *res cogitans* or soul which only human beings with their capacity for mental self-awareness possess.

There is of course, much in the Descartes' concept of the reflex arc which is still valid. The idea that the nervous system and the brain of which it forms part, is a device for transforming excitation generated at the sense organs into a muscular output, is still with us and unlikely to be challenged in the future. The same is true of the notion that at the level of neuron and its synaptic connections with other neurons, neural activity is a mechanical process. It is the appeal to these mechanical processes at the molecular level which justifies the claim made on behalf of the contextualist, that neuropsychology is inescapably committed to the mechanical model. What that claim ignores is the growing body of evidence from the work that has been

done in recent years by connectionists and others on the properties of neural networks which shows that relatively simple mechanical principles at the level of the neuron and its synaptic connections yield the ability at the level of the network as a whole to respond to all the subtlety and variety of contextual cues with an equally subtle variety of outputs.

Mechanism in behavior analysis

Among the behaviorists who have focused on the environment-behavior interface rather than the brain-behavior interface there was a time when the mechanical model represented either by concepts such as ‘the conditioned reflex’ and ‘the stimulus-response connection’ dominated the field. Skinner, though he was more responsible than anyone else for breaking away from this idea, still retained some traces of it. But once you begin to think of behavior, as he encouraged us to do, as an adaptation to environmental contingencies, it becomes apparent that, since those contingencies all involve multiple synchronous causes, such adaptation can only succeed in so far as it is sensitive to and controlled by the multiplicity both of the environmental context and the organism's motivations with respect to it.

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