Causality
(First Draft)

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This essay comprises elements of the critical discussion of an alternative approach to the concept of causality. So far, philosophical theories of causality have postulated that the causal connection between events is encouraging or supportive. The alternative discussed here assumes that there is no such thing as support of one event for another. It starts from the idea that the influence between events is inhibitory at best. Simply put, causality is inhibition.

This assumption does not stand alone. It goes hand in hand with a cosmological theory that describes events as realizing possibilities. Degrees of realization and the interpretation of relative probability as a measure of inhibitory effects allow for the use of mathematical means to describe a changing reality.

The philosophical theory proposed here, or "potentialism" for short, only provides a partial answer to the question how events interact causally. It does not answer the question how this inhibitory effect is conveyed as, for example, Descartes' theory of push does. All in all, the proposed theory erects a scaffolding for theories to come.

Events are actualizations of possibilities. Degrees of realization describe this process of actualization. In its general form this cosmology does not answer the question what these possibilities exactly are. It is possible to combine this theory with the idea that the cosmos consists of space inhabited by mass particles. The fall of an apple is then a realizing possibility. The only influence realizing possibilities can have on each other is inhibitory or suppressive. Pushing down one side of a seesaw lifts up the other side. The degrees of realization of both events are connected causally. Actualizing one possibility, i.e. increasing its degree of realization, rolls back the degree of realization of the other possibility.

This view of causality explains the existence of random events. The flat surface of a table together with the shape of a coin creates two mutually exclusive possibilities. Moreover, the inhibitory influence creates weights for realization or propensities.[1] The propensities can be calculated from the total and mutual inhibition of the two possibilities.

Inhibition is not always complete. There are degrees of inhibition. An example will be discussed below. Here, the question is whether there is a suitable measure for these degrees of inhibition. The relative probability p(a, b), the probability of a with regard to b, is a suitable measure. In this interpretation 'p(a, b) = 1' does not say that b is the cause of the effect a. It says that a is not at all inhibited by b. On the other hand, 'p(a, b) = 0' says that a is completely inhibited by b. Measures of inhibition between 0 and 1 reflect partial inhibition. This interpretation of the relative probability calculus will be elaborated upon below with the discussion of examples.[2]

To conclude, the relative probability rises with decreasing inhibition and, vice versa, it decreases with rising inhibition. This section gave just a brief exposition of the theory.

The following examples shall illustrate the above philosophical theory. The first example is a row of n dominoes. The arrangement makes sure that all n dominoes

1. For the theory of propensities see: Popper, *Realism and the Aim of Science*, section *53, and Popper, "A World of Propensities," *9–21*.

2. For the calculus of relative probability see: Popper, *Logic of Scientific Discovery*, New Appendices *IV, *V.

will topple over when the first one falls. The cause and effect theory of causality describes each fall as the effect of the previous fall and the cause of the subsequent fall. The sequence of events forms, according to this theory, a causal chain with the supportive cause and effect relation as a linking element.

In order to describe the domino effect in terms of potentialism, more substantial ideas are necessary. The fall of the dominoes is prevented by the position of their centers of gravity. It is positioned between the edges of the blocks. The gravity of the earth will pull them down as soon as this condition is eliminated. The fall of the neighbor does not knock down the next block; it changes the position of its center of gravity. Once the center of gravity has reached a certain position on the x-axis the fall is set in motion.

The energy picture of the domino effect is interesting because it is similar to certain chemical reactions that need a specific amount of activation energy and then carry on without further intervention from outside the system. Tipping a domino block lifts up its center of gravity and thus injects energy into the system. This energy is passed on from falling domino to falling domino. The fall of each domino as a realizing possibility does not cause the fall of the next block but it simply removes the inhibiting condition. It rolls back the inhibitor. Then, gravity pulls down the block. This analysis shows how potentialism simulates the cause and effect theory of causality. It achieves this by introducing an additional event. This event inhibits the effect; the former cause rolls back the inhibitor. The cause and effect relation between events can thus be analyzed in terms of potentialism.

The next example consists of an apple hanging down from the ceiling by a thread. The thread is cut by a pair of scissors. Clearly, the apple falls down. As long as the thread was intact, it prevented the apple's fall. Cutting the thread removes this obstacle and the apple falls.

Within the cause and effect theory there is another way to look at the above example. The cause of the apple's fall is the force between the earth and the apple. Generally, forces cause effects.

Can potentialism counter this critical argument? The important question is whether the force, in fact all forces, actually encourage change. Isaac Newton assumed that forces change the way mass objects move. His lex secunda postulates that objects remain in rectilinear uniform motion unless a force changes this. To counter the above argument, potentialism must interpret this force as an inhibitory effect of one mass object onto another.

The next two examples consist of random processes. The critical question is whether potentialism can explain the link between causality and randomness and, more specifically, whether increasing propensities in changing situations are due to encouraging causal influences. The first example is a three sided die that is tossed twice. The constant background conditions or events are such that three distinct possibilities exist. The propensity for each outcome is 1/3. “H,” “S,” and “T” are names for the three possible outcomes of the first throw and “HH,” “HS,” etc. are names of the possible outcomes after the second throw. The propensity of HH before the first throw is 1/9. If the first throw exhibits H, HH's propensity becomes 1/3. It has tripled. Does this warrant a theory of the causal connection as support?

The following interpretation of this example is in accordance with potentialism. The relative probability of a with regard to b measures the inhibitory influence of b on a. A measure of 1 says that a is not at all inhibited by b, but that a's complement is completely excluded. The relevant theorem of the calculus is : p(a, b) + p(ā, b) = 1. It follows: if p(a, b) = 0 then p(ā, b) = 1. A relative probability of 0 says that a is completely excluded and ā not at all. It is important to notice that the relative probability measures the inhibitory influence of possibilities on each other and not the propensity of a if b has happened. What about relative probabilities between zero and one? If p(a, b) = ½, then p(ā, b) = ½. Both a and its complement ā are inhibited with the same measure. If p(a, b) = ¾ then b inhibits a only slightly. The measure of inhibition is 1 – p(a, b). With p(a, b) = ¾ it is 1 - ¾ = ¼.

To sum up, a high relative probability conveys that only a weak inhibition is exerted onto a possibility and a strong inhibitory influence onto the complement. The increasing propensity of HH is due to inhibitory effects on its complement and not due to encouraging causal effects on itself.

Absolute probabilities measure propensities; relative probabilities measure inhibitory effects. p(HH) = 1/9. p(H) = 1/3. p(HH, H) = 1/3. H excludes a number of possibilities: p(S, H) = p(T, H) = p(SH, H) = p(ST, H) = 0, etc. p(HH) equals 1/3 if H happens. It equals 1/9 if nothing has happened. If H happens, several propensities are reduced to zero. The sum of the propensities excluded by H equals 6/9. The propensities of HH, HS, and HT increase each by 2/9 if H happens. This increase, it seems, is fed by the exclusion of formerly non-zero propensities. Specifically, p(H) equals one because all its alternatives have been reduced to zero. The following calculation determines p(HH). 1/3 = p(HH, H) = p(HHH) / p(H) = p(HHH) = p(HH). This deduction infers p(HH) from relative and absolute probabilities. Here, HHH is not the possibility that H occurs three times in a row. It is the possibility that H occurs in the first throw and HH in the second. Since p(H) = 1, p(HHH) = p(HH). The inhibitory effects of H on HH, HS, and HT are equal. Therefore, HH's, HS's, and HT's propensities are identical if H happens. Generally, inhibitory effects determine propensities.

To conclude, examples of increasing propensities under changing conditions do not refute or undermine the theory of causality as inhibition. Increasing propensities are, according to this theory, due to the elimination of competing possibilities. The possibilities left behind have, thus, higher propensity values.

The final example makes the descriptive means more realistic by introducing degrees of realization. It comprises n structures, named “towers” or “stacks.” Change in this model is the movement of blocks from one tower to an adjacent one. Each tower has an inhibitory effect on its neighbors depending on its degree of realization. This degree is simply the number of blocks on the stack or tower. With an increasing degree of realization the inhibitory effect of a tower on its neighbors grows stronger and, therefore, the propensities of those neighbors to unload blocks onto an already high tower decreases. In other words, a high tower repels blocks of adjacent towers. The stronger inhibition leads to a lower degree of realization of the inhibiting tower. A computer simulation could maintain relative probabilities as measures of the inhibitory power for each tower and calculate propensities to dump blocks on the fly. Possible variations of this model include constant degrees of inhibition and specific distributions of these degrees over the structure of n towers. These variations are not discussed here.

The one variation briefly discussed comprises a simplified view of the structure. Each tower has two values; the first represents its degree of realization, the second measures its propensity to receive a block in the next step. This propensity is the result of its own degree of realization and the inhibitory influences of the neighbors. Degrees of realization and propensities can change simultaneously. They depend on each other. From here, a direct path leads to the problem of the interpretation of the mathematical formalism of Quantum Theory. The leading question is whether the approach advanced here provides a solution for these problems.

To conclude, potentialism provides a basis for the description of the cosmos in terms of mutually dependent fields of propensities and degrees of realization.

This essay has formulated a general theory of causality along with elements of its critical discussion. It has not drawn a new (metaphysical) picture of the cosmos that answers the question of how events affect each other causally; and there might be no general answer to this question because different kinds of events interfere differently; but the universal character of the theory proposed here facilitates its critical discussion. A touchstone for every theory of causality is the mind-body problem. How does potentialism transform this problem? Answering this question is beyond the scope of this essay.[3]

3. See my essay "The solution of the mind-body problem" on matti-ilgmann.net.

Bibliography

Popper, Karl. *The Logic of Scientific Discovery*. London and New York: Routledge Classics, 2007.

———. *Realism and the Aim of Science*. London and New York: Routledge Taylor & Francis Group, 2003.

———. “A World of Propensities: Two New Views on Causality.” In *A World of Propensities*, 1–26. Bristol: Thoemmes, 1990.