Hybrid Nature of Causation

A Consideration from Some Ethical Issues

MASAKI ICHINOSE

Department of Philosophy
Graduate School of Humanities and Sociology
The University of Tokyo

ABSTRACT

In this paper I will explore the nature of causation in our ethical judgements. Generally speaking, the causal relation is regarded as something to be objectively confirmed. This is certainly true, but is not perfectly true. There are several cases where the causal relation could not be confirmed in principle only by investigating something objective in a scientific or statistical way. I will examine two ethical cases. The first is the case of the causal relation between exposure to low dose radiation and dying of cancer, which has become controversial because of Fukushima nuclear plant's accidents since March 11th, 2011 in Japan. The second involves causal relations in which the cause of the effect is the non-occurrence (rather than the occurrence) of an event, a typical example of which is the alleged deterrent effect of the death penalty. I aim at clarifying that the causal relation involves something narrative as well as objective, whereby I hope to show the hybrid nature of causation.

CAUSATION MATTERS

In this article, I will argue that a causal relation appearing as a key idea in ethical or social justice issues is so perplexing that we should be extremely careful in apply-

ing it to those issues. It is theoretically important for us to be free from presuppositions or conceptual biases while making causal judgements. I will develop my argument by focusing in particular upon the two following cases:

1. *Death penalty deters people from committing crimes in the future (DEDP).*

2. *Exposure to low-dose radiation causes people to die of cancer (ELDR).*

Obviously, ELDR is a kind of causal claim that asserts the causal relation between exposure to low-dose radiation and cancer death. Japan has been subject to complete and utter confusion about ELDR since 11 March, 2011, when a massive earthquake and tsunami occurred, bringing about equipment failure and damage that resulted in the release of radioactive materials at the Fukushima nuclear power plant. We have to admit that some radiation or radioactive matter was emitted from the nuclear plant and we—and in particular, people living in the eastern parts of Japan—have been exposed to a higher degree of radiation than before. However, the true problem here is not our increased exposure to radiation; instead, it is precisely the causation between exposure to radiation and cancer death. If such causation does not exist at all, there is no problem, no matter how much radiation we are exposed to. Sometimes people consider the issue of radiation exposure as a fundamental problem independent of its causal relation to health problems, which is a grave error. We have to focus on the essential issue, that is to say, the causal relation.

How, then, should we understand DEDP? I am fully convinced that DEDP is another kind of causal assertion. What DEDP asserts is that the existence of the death penalty system causes a decrease in serious crime. Or, more precisely, DEDP claims that the existence of the death penalty causes the non-existence of serious crime. This may seem a strange sort of causal relation; however, it is undoubtedly a causal relation. In any case, to understand causal judgments such as DEDP or ELDR, which are deeply entrenched in our moral decisions, we must focus upon causation itself. Therefore, let us begin an analysis of causal relations from a philosophical point of view.

A RELIC OF A BYGONE AGE

We observe causal relations in physical phenomena. I drop my pen on the floor, and a sound is heard. This is one of the clearest examples of a causal relation. A cause occurs, immediately followed by its supposed effect. However, we often take two events separated by a long interval to be causally connected. For instance, we could say that

- Heavy snowfall caused a traffic jam (Proposition 1).

In this case, the moment it snows is not necessarily the same moment the traffic jam occurs. Nevertheless, we have no problem in understanding these events to be causally related. Roughly speaking, we could safely say that natural science primarily aims at clarifying the causal relation in this world.

Bertrand Russell once fiercely criticised the notion of cause by pointing out the impossibility of necessary connection between cause and effect in the physical world given the structure of time-series. Moreover, he presented his unique view of science in terms of functional relations rather than causal ones. Russell's argument was as follows:

> *i) 'No two instants are contiguous, since the time-series is compact' (Russell 1956: 177).*
>
> *ii) 'If there are causes and effects, they must be separated by a finite time-interval t' (Russell 1956: 177).*
>
> *iii) 'However short we make the interval t, something may happen during this interval which prevents the expected result' (Russell 1956: 179).*

Therefore, it is impossible to define the causal relation in terms of (spatio-) temporal contiguity.

Russell gives a negative evaluation of causal concepts because, as we saw, it is theoretically difficult or impossible to explain the occurrence of cause and effect in the time-series. He argues that

> *the law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously posed to do no harm. (Russell 1956: 173)*

What then about the possibility of interpreting cause as occurring completely simultaneously with its effect? Unfortunately, this route might not be at all promising because of Hume's famous objection against the simultaneity theory of causation:

> *If any cause may be perfectly co-temporary with its effect, 'tis certain ... that they must all of them be so ... The consequence of this wou'd be no less than the destruction of that succession of causes, which we observe in the world; and indeed, the utter annihilation of time. (Hume 2000: 54)*

Consequently, if a cause precedes its effect, then it would not be the cause; and if a cause is simultaneous with its effect, the annihilation of time would result (setting the possibility of backward causation aside here). As far as we accepted a combination of their arguments (Hume's argument itself seems to be reasonable although Russell's might not be so), causal relations do not obtain; contrary to our common sense.

However, we still continue to use causal notions in everyday life as the example of the snowfall and traffic exemplifies, even though a hundred years have passed since Russell made his argument. The same is true in academic research. Medical research still seeks causes of particular diseases. Etiology comprises one of the fundamental cores of medicine. Why is this so? It seems to me that Russell overlooked the wide range that causal notions cover. Or, at least, Russell intentionally or unintentionally restricted the domain of causality too much. A couple of points need to be clarified.

First, we have to examine the tasks philosophy should be engaged in. In principle, there could be two possible tasks of philosophy with regard to how to deal with our ordinary concepts: (1) Philosophy should try to alter our dictionary or eliminate some words in the dictionary by exposing something vague or imperfect about our ordinary concepts; or (2) philosophy should elucidate what implications could be drawn from our ordinary concepts, accepting something vague or imperfect in those concepts as reality or defaults. As far as I understand, Russell seems to be engaged in conducting the first task. His strategy is analogous to what is called eliminativism in the field of the philosophy of mind. However, I cannot help thinking that philosophers ought not to violate the right of editors of dictionaries. Editing dictionaries is

beyond the territory of philosophers as they are neither omnipotent nor authorised to deal in all things. In this respect, the first task Russell focused on seems to distort the proper practice of philosophy. As per my understanding, the second task looks overwhelmingly sound in comparison to the first. That is, philosophy should accept the actual usage of causal concepts and scrutinise those rather than abandoning them as Russell suggested. This might explain why Russell's arguments on causal concepts have not been influential.

PHYSICAL AND METAPHYSICAL

The second point to note is that Russell seems to require an overly meticulous precision in specifying the notion of cause. He seeks location of the cause of a particular effect in time so that the cause can be claimed to be nowhere. At first glance, this sounds rigorous enough to be suitable as philosophical analysis. However, in reality, this rigorous attitude to causal concepts is unfortunately inappropriate. Certainly, we apply causal concepts to physical phenomena to understand the situations occurring in the world; however, the method we use to apply these concepts differs from the method used to apply concepts of perceivable events or objects. We can, theoretically, identify events or physical objects by denoting those. To put it another way, generally speaking, events or physical objects must be the ontological basis for us to understand the world in an extensional manner so that we can identify (at least some of) them by definition. Otherwise, we cannot begin our understanding of the world. However, the same is not true of causal concepts. Simply speaking, a particular cause of a particular effect cannot be uniquely identified or specified in principle, which is the very nature of the notion of cause.

This is illustrated by the snow and traffic proposition above. In the proposition, the heavy snowfall is assigned as the cause of the traffic jam. We often believe propositions like this to be true whilst also believing similar, apparently competing propositions to be true. It is perfectly possible, for example, to assign the cause of the traffic jam to the road network, when we judge that the traffic jam would be unlikely to occur even after heavy snowfall if the road network were more orderly. This assignment of the cause to the road network would be more persuasive if the neighbouring city with an excellent road network suffered no traffic jams at all despite having the same amount of snowfall. Similarly, it is perfectly possible to assign the cause to the large number of traffic signals if the neighbouring city with a smaller number of traffic

signals suffered no traffic jams at all despite having the same amount of snowfall. In those cases, heavy snowfall works only as a trigger or a sufficient condition to begin the true cause.

Where does this flexibility in the notion of cause come from? Why do each and all of those different assignments sound appropriate? This is because a causal relation itself is intrinsically unperceivable so there is room to change the assignment of the cause to a certain extent. The unperceivable character of cause was classically pointed out by David Hume, when he referred to constant conjunction in investigating causal connection. Only a temporal series or succession of different events or objects is perceivable; their causes are not directly perceivable. Therefore, we have to observe certain unique and external characteristics such as constant conjunction around what is supposed to be a causal relation to analyse causation. This situation seems to suggest the *metaphysical* nature of causation. In fact, the issue of causation is universally classified as a metaphysical problem. Historically speaking, causation has been discussed in the context of the relations between God and the world, or between free will and our actions, which are genuinely metaphysical. That is, although causation is supposed to obtain in the physical world, its nature is intrinsically metaphysical as well. However, at the same time, as far as we search for causation in physical phenomena, the flexibility of the assignment of a particular cause of a particular effect is restricted to a certain extent by physical possibilities (i.e. it is not the case at all that anything goes). In this respect, causation should be treated as a *physico-metaphysical* relation.

CAUSATION AS TO INSTITUTIONAL FACTS

The argument about causation, however, must not stop here. The third point in relation to Russell's argument is that causal relations can matter considerably in ethical issues. This aspect of causation is completely overlooked by Russell's argument, although he might have had some positive reason to do so. Of course, causation between free will and human actions has been discussed as one of the traditional subjects in the history of philosophy, which Russell also notes. However, I want to highlight the context where the causal relation works in a replaceable way with the notion of responsibility based upon some social or institutional backgrounds. Let us consider these three examples:

- The president's inactivity caused the bankruptcy (Proposition 2).

- Her careless pass caused our defeat (Proposition 3).

- His emphasis on the danger of radioactivity caused many people's radiophobia and political protest against nuclear power stations (Proposition 4).

Those are perfectly appropriate and understandable as assertions of causal relations despite being impossible in principle to reduce those relations to physical causation, because those causal relations obtain only based upon some institutions.

Perhaps this range covered by causal concepts, namely, institutional and physico-metaphysical phenomena, could be regarded as corresponding to two types of facts once proposed by John Searle. He proposed a dichotomy between brute facts and institutional facts, and gave the following examples of brute facts (Searle 1969: 50):

- This stone is next to that stone (Proposition 5).

- Bodies attract with a force inversely proportional to the square of the distance between them and directly proportional to the product of their mass. (Proposition 6).

On the other hand, Searle gives the following examples of institutional facts (Searle 1969: 51):

- Mr Smith married Miss Jones (Proposition 7).

- The Dodgers beat the Giants three to two in eleven innings (Proposition 8).

Searle distinguishes institutional facts from brute facts as follows: there is no simple set of statements about physical or psychological properties of states of affairs to which statements of institutional facts are reducible (Searle 1969: 51). If we adopt the scheme such that causation obtains between facts (I believe this is actually the case), we could naturally apply causal relations to institutional as well as brute facts. That is precisely what Russell overlooked or intentionally set aside.

CAUSALITY AND RESPONSIBILITY

I believe it possible that this institutional aspect of causation universally permeates causal relations, at least at a fundamental level, although in that case the distinction between brute and institutional facts might finally be abandoned. We can at least propose this possibility as a research programme, where we are expected to elucidate the nature of causation by presupposing the possibility as a hypothesis and searching for what would result from the presupposition. In fact, the possibility could be confirmed to a certain extent by English usage of 'cause' and 'responsibility'. It is perfectly possible to replace Proposition 1 with the following:

- Heavy snowfall is responsible for the traffic jam (Proposition 1*).

Needless to say, similar replacements make perfect sense in the cases of Propositions 2, 3 and 4. Relatedly, there is a paper by Elliot Sober entitled, 'Apportioning causal responsibility', where he uses the notion of responsibility as 'cause' (Sober 1988). Etymologically speaking, 'responsibility' and 'cause' originate from the same Greek word, 'αἰτία'. Etiology in medicine, of course, corresponds precisely to the original Greek word. (In Japanese as well, remarkably, there is a word meaning both 'cause' and 'responsibility', i.e. '*no-se-i*'.) In addition, obviously, the notion of responsibility presupposes some institutional system. At least, a language of 'responsibility' seems to be rather different from a language of purely natural phenomena (i.e. phenomena at quantum-mechanistic level), as natural phenomena could admit an endless chain of how-questions in principle, whereas 'responsibility' and 'cause' seems to demand a stopping point somewhere by definition.

Consequently, if all this is true, it seems that the notion of cause intrinsically involves some *normative* implications given the intrinsic connection between cause and responsibility under certain institutional conditions. That is,

> *Accepting 'A causes B' in some institutional conditions entails that 'we ought to attribute responsibility for B to A'.*

Let us return to Proposition 1. In a certain institutional context (in other words, in a customary context or from the viewpoint of, for example, the city government in this case), *the heavy snowfall* rather than the road network or the large number of traffic signals *ought to* be viewed as a cause of the traffic jam.

This suggests that causal judgements imply something narrative as well as objective because, speaking purely objectively, it is almost impossible to uniquely identify a specific thing as being responsible for (i.e. causing) a particular phenomenon. The process of uniquely identifying causes is arbitrary to an extent, hence narrative factors are needed to make judgements. To put it another way, as far as we understand 'causation' simply and in a restricted way as an objective mechanism (if any), 'causation' alone is insufficient to establish responsibility, particularly moral responsibility in a normative sense. The following remark by Michael Moore corresponds to this point:

> *The moral view reflected in the structure of Anglo-American criminal law makes causation of some harm neither sufficient nor necessary for moral responsibility. (Moore 2009: 21)*

However, conversely, if we understand 'causation' in a broader sense to subsume the use of the concept of responsibility, 'causation' of itself should involve something narrative and normative. Moore's remark, in reality, intimates that 'causation' intrinsically has a narrative or normative nature, as his main thesis involves elucidating problems of responsibility by connecting responsibility with causality. In fact, considerable evidence about our causal understandings, including those discussed previously, seems to indicate that the broader sense of 'causation' is actually dominant in our linguistic activities. We are at least permitted, therefore, to presuppose the broader sense of 'causation' as one hypothesis. Thus, for the time being, we can say that causal relations are not only *physico-metaphysical* but also *normative*. They are intrinsically *hybrid*. This is destined to be perplexing!

NECESSITY OR PROBABILITY

I have already discussed three issues concerning Russell's argument. However, there is also a fourth point to be noted: Russell's argument presupposes that causal relations logically require the necessary connection between cause and effect. However, this presupposition is simply wrong, or at least incongruous with our everyday usage of causal concepts, as we ordinarily use causal concepts without the notion of causal necessity. We might reflect this feature of our ordinary attitude towards causal rela-

tions by introducing the concept of probability, which opens a new way (that started after Russell's argument at least as a philosophical discussion) to investigate the nature of causation.

The next example is one of the most popular cases referred to in this context:

- Smoking causes lung cancer (Proposition 9).

We do not apply the notion of causal necessity to propositions such as Proposition 9, as there are many exceptions. In fact, there are examples of people who enjoyed smoking into their 90s and subsequently died of old age.

How then do we verify whether such types of causal judgments are true or not? We verify them in terms of statistics or epidemiology; that is, we introduce probability. In this context, 'probabilistic causality' is the most dominant view, and has been developed through arguments by *inter alia:* Reichenbach, Good, Suppes, Salmon, Cartwright and Eells and so on. What then is the core idea of probabilistic causality? Here, I rely on Nancy Cartwright's formulation, paraphrased by Jon Williamson:

> *C causes E iff P(E | CK) > P(E | K) for all states K of the E's other causes that are not between C and E. (Williamson 2009: 193)*

This idea of probabilistic causality defines causation in terms of probabilistic dependence rather than only using probabilistic dependence as evidence of causal relation. In this sense, this claim is so strong that many objections and counterexamples have been raised.

In any case, DEDP and ELDR, raised at the beginning of this article, are good candidates for applying the idea of probabilistic causality. This is because neither DEDP nor ELDR make any commitment to a claim of necessary connection. Both DEDP and ELDR clearly admit of exceptions. Given this, we must seriously consider, at least at first, the idea of probabilistic causality as well as the hybrid nature of causation in order properly and carefully to evaluate the significance of both cases.

DETERRENT EFFECT OF THE DEATH PENALTY

Let us now apply my arguments thus far directly to DEDP and ELDR, beginning with DEDP. The argument for the deterrent effect of the death penalty probably arises from 'common sense' thinking. For example, Pojman argues that 'there

is some non-statistical evidence based on common sense that gives credence to the hypothesis that the threat of the death penalty deters and that it does so better than long prison sentences' (Pojman 1998: 38–39). Specifically, this deterrent effect presupposes the utility calculus that a human being conducts, whether consciously or unconsciously, in terms of 'weighing the subjective severity of perceived censure and the subjective probability of perceived censure against the magnitude of the desire to commit the offence and the subjective probability of fulfilling this desire by offending' (Beyleveld 1979: 219). Therefore, if we presuppose the basic similarity of human conditions, it may be plausible to state the following about the deterrent effect of the death penalty: 'this can be known *a priori* on the basis of an analysis of human action' (Beyleveld, 1979: 215). However, in fact, the death penalty is specifically restricted to heinous crimes, such as consecutive homicides, which suggests that we must conduct empirical studies, case by case, if we want to confirm the deterrent effect of the death penalty. Therefore, the relevant question to ask about the deterrent effect is not whether the death penalty is theoretically effective or not, but rather how actually effective it is in restricted categories of crimes.

It is well known that there have been many statistical surveys concerning this issue. In particular, an economic investigation by Ehrlich is frequently mentioned as a typical example of statistical work on the issue. After examining detailed statistical data in terms of various factors, such as race, hereditary characteristics, education and cultural patterns, Ehrlich suggests

> *An additional execution per year over the period in question [i.e. 1935–1969] may have resulted, on average, in 7 or 8 fewer murders. (Ehrlich 1975: 414)*

Of course, this estimation includes too many factors and presumptions to be perfectly accurate. Ehrlich himself is aware of this, and thus argues:

> *It should be emphasized that the expected tradeoffs computed in the preceding illustration mainly serve a methodological purpose since their validity is conditional upon that of the entire set of assumptions underlying the econometric investigation … however … the tradeoffs between executions and murders implied by these elasticities are not negligible, especially when evaluated at relatively low levels of executions and relatively high level[s] of murder. (Ehrlich 1975: 414)*

Ehrlich's study provoked considerable criticism, most of which indicated insufficiencies in the statistical methodology of his study. Therefore, we should conclude that we are not able to infer anything definite from Ehrlich's study, although we should value the study as a pioneering work. Therefore, uncertainty still exists regarding the issue.

Van den Haag proposes an interesting argument based upon uncertainty peculiar to the deterrent effect of the death penalty. He considers two cases, Case 1 wherein the death penalty exists, and Case 2 wherein the death penalty does not exist. Risk or uncertainty exists in each case. On one hand, in Case 1, if there is no deterrent effect, we simply lose the life of a murderer in vain, whereas if there is a deterrent effect, some murderers and innocent victims in the future will be saved. On the other hand, in Case 2, if there is no deterrent effect, we save at least the life of a convicted murderer, whereas if there is a deterrent effect, we will lose the lives of some innocent victims in the future (Van den Haag 1969: 133–134). Conway and Pojman represent these outcomes by means of 'The Best Bet Argument' table, which I have slightly modified:

WAGER

	DE works	*DE does not work*
We bet DP works	save: murderers and innocent victims in the future lose: convicted murderers	save: nothing lose: convicted murderers
We bet DP does not work	save: convicted murderers lose: innocent victims in the future	save: convicted murderers lose: nothing

Note: DP represents Death Penalty and DE represents Deterrent Effect in the above table.

Following this table, Conway assumes (after Van den Haag's suggestion that the life of a convicted murderer is not valued more highly than that of the unknown victims) the following numerical values for each case:

A murderer saved = +5

A murderer executed = –5

An innocent saved = +10

An innocent murdered = –10

Moreover, he assumes that for each execution, only two innocent lives are spared. Then, consequently, executing convicted murderers becomes a good bet (Conway 1974: 265–66, Pojman 1998: 40–41).

NEGATIVE CAUSATION

Van den Haag's 'Best Bet Argument' is very interesting. However, Conway has already proposed a fundamental challenge to this argument; namely, this argument mistakenly regards the *actual* death of convicted murderers as being on a par with the *possible* death of innocent victims in the future (Conway 1974: 269–70). Certainly there seems to be confusion or possibly a trick in 'The Best Bet Argument'. I believe Conway's challenge is a reasonable reaction to Van den Haag's argument.

I will raise two problems regarding Van den Haag's argument. First, as I have already mentioned, we have to confirm that any argument—including Van den Haag's—supporting the death penalty because of its deterrent effect presupposes a causal relationship between the existence of the death penalty and people not killing others. (I presume crimes corresponding to the death penalty are killing people for brevity. I believe that this presumption is actually correct). For example, Pojman writes, 'the repeated announcement and regular exercise of capital punishment may have deep causal influence' (Pojman 1998: 48). However, epistemologically speaking, the presupposition is extremely difficult to confirm because the effect of this causal relationship is not a positive but rather a negative event, which is the event of *not* killing others. This is related to the philosophical problem of how to understand negative properties.

By negative properties we mean, for example, this room is not full of sea water; this room does not consist of paper; this room is not melting us, etc. We can immediately find that such descriptions of negative properties are almost endlessly possible. In other words, one identical event described by a positive property (e.g. this room is well lit) can be re-described in infinite ways in terms of negative properties. Take the example (that actually occurred in May 2012) that I am giving a presentation now in Tokyo; however, this event can also be described as 'I am not eating', 'I am not sleep-

ing', 'I am not killing others'(!), etc. The positive event, 'I am giving a presentation now' can be understood through a causal relationship. Probably the event was caused by my intention, which was caused by my relationship with the Uehiro Foundation and the Uehiro Centre of the University of Oxford. However, then, what about 'I am not killing others'? What caused my present state described as 'I am not killing others'? Was this caused by the existence of the death penalty in Japan? I was completely unaware of the existence of the death penalty in Japan when I gave the presentation. Could the death penalty be its cause? Could the negative event, 'I am not killing others', be an effect of the death penalty? If it is, it is tremendously difficult to say how.

Of course, someone may raise an objection that statistical correlation between the number of executions and the number of homicides is relevant in this context, rather than a singular causal relation. This could probably be confirmed in terms of the scheme of probabilistic causality that I introduced before. However, this kind of correlation between categories of events is too rough to predict a causal relationship between them. This, in my view, is the second problem with Van den Haag's argument. Causes to reduce or increase the number of homicides can be interpreted or estimated in various ways (considering confounding factors, such as education, economic situation, urban planning and so on). Therefore, in principle, there always remains the possibility that the apparent correlation between the death penalty and the reduction of homicides is merely accidental. There may be another, common cause that brings about both people's tendency to support the death penalty and the reduction of homicides. We should recognise that there is intrinsic uncertainty here. This point is a fundamental problem with the idea of probabilistic causality in general.

I wish to add one further remark, following my arguments above. Some data about probabilistic dependence with regard to the relation between the number of executions and the number of murders are academically worth collecting and investigating. This is because those data could work as evidence at the level of our conviction or persuasion, apart from purely objective confirmation of the causal relation concerned. This aspect corresponds to the physico-metaphysical nature of causation. However, this is not sufficient. We should reflect on how to reach a social agreement about whether or not the supposed causation between the deterrent effect and the death penalty functions as the justification for the death penalty. This issue lies not at the physico-metaphysical level but at the normative level. Statisticians who are

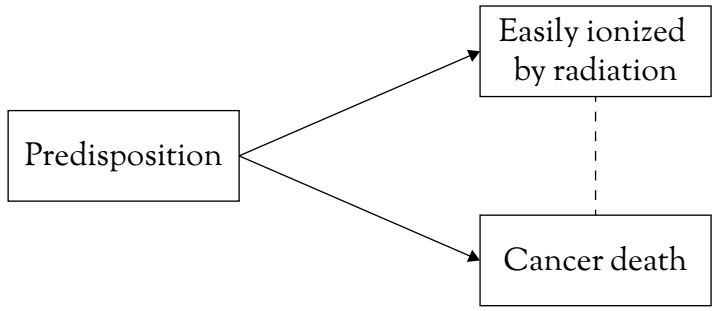
interested in the issue of the deterrent effect of the death penalty must conduct their research while being clearly aware of this normative aspect of the problem. We must avoid treating this issue as if it can be resolved by considering statistics alone. Of course, there is another more fundamental question about whether the death penalty should be retained (or revived) or abolished (or left abolished), which is beyond the topic at hand here.

EXPOSURE TO RADIATION AND CANCER DEATH

Lastly, I return to the case of ELDR, which is, as I said, a very controversial topic recently in Japan. However, here I only focus upon the supposed causal relation between exposure to low-dose radiation and cancer death. First, we should say that we have to conduct further scientific research on this causal relation from epidemiological or molecular-biological perspectives. Only that research has the potential to provide the information necessary to decide how to tackle the problem. This is a relatively natural strategy given the physico-metaphysical nature of causal relations, although such research is not easy at all. In addition, we must point out that such research must involve scrutinising probabilistic relations. That approach is a characteristic of epidemiology or molecular biology.

However, in the same way as the case of DEDP, there are some crucial difficulties in investigating causation through studying probabilistic dependence.

First, as noted with regard to the case of DEDP, we could not eliminate the possibility that a common cause exists. We are now exploring causation between the exposure to low-dose radiation and cancer death. In addition, the causation is supposed to manifest itself in such a way that radiation ionises our cells to produce active oxygen which finally damages our cells and DNA, and the damage could result in cancer and death. However, we cannot theoretically deny the possibility that there is a common cause of both our being likely to be damaged by active oxygen and death from cancer. For example, it might be that some people have an inborn predisposition that is highly likely to cause them to be more easily ionised by radiation. At the same time, this inborn predisposition may be highly likely to cause them to suffer from cancer and die, irrespective of whether they are exposed to radiation or not. This possibility can be delineated in the next diagram.



In this diagram, the arrow represents probabilistic causation, and a dotted line shows only a non-causal correlation. If this is actually the case, avoiding exposure to radiation does not prevent us from dying of cancer. That may be useless resistance. If we have the relevant predisposition, we would probably die of cancer irrespective of whether we are exposed to radiation.

SIMPSON'S PARADOX

In addition, when we make causal judgments based upon probabilistic dependence, we are involved in a serious paradox. Philosophers who refuse the idea of probabilistic causality, such as Nancy Cartwright, take what is called 'Simpson's Paradox' seriously. Actually, I also think that Simpson's Paradox is fatal to the idea of probabilistic causality, except when we use probabilistic dependence as evidence rather than to define causation. I show here how Simpson's Paradox operates in the relation between exposure to low-dose radiation and cancer death, taking the example of exposure to 5 mSv/y radiation (as effective doses), which must be accepted as low-dose radiation according to contemporary understandings of radiation.

Let us examine the next inference:

1. the probability for male individuals exposed to more than 5 mSv to die of cancer is higher than that for male individuals exposed to less than 5 mSv.

2. the probability for female individuals exposed to more than 5 mSv to die of cancer is higher than that for female individuals exposed to less than 5 mSv.

3. therefore, the probability for all individuals (male and female) exposed to more than 5 mSv to die of cancer is higher than that for all individuals (male and female) exposed to less than 5 mSv.

This valid inference can be represented as follows (See Pearl 1988: 496, Malinas 2003: 171):

1. $p \supset r$

2. $q \supset r$

3. $(p \vee q) \supset r$

(1) & (2) $\supset$ (3) looks logically true.

However, the next case is perfectly possible (where each number stands for number of people, 'ca.de' stands for 'dying of cancer', and 'no ca.de' stands for 'not dying of cancer').

TABLE 1

	female		*male*		*female & male*	
	ca.de	*no ca.de*	*ca.de*	*no ca.de*	*ca.de*	*no ca.de*
more than 5 mSv	20	40	20	10	40	50
less than 5 mSv	15	40	90	50	105	90

In this scenario, females exposed to more than 5 mSv have a 20/60 probability of dying of cancer, whilst for females exposed to less than 5 mSv the probability is 15/55. 20/60 is greater than 15/55. (2) in the inference above obtains. Similarly, males exposed to more than 5 mSv have a 20/30 probability of dying of cancer, compared to a 90/140 probability for males exposed to less than 5 mSv. 20/30 is greater than 90/140. (1) in the inference above obtains.

However, when we consider the population as a whole, those exposed to more than 5 mSv have a 40/90 probability of dying of cancer, compared to a 105/195

probability for those exposed to less than 5 mSv. 40/90 is less than 105/195. (3) does not obtain despite (1) and (2) being true. This is Simpson's paradox (see Malinas and Bigelow 2004: 3). This suggests that the logical symbolisation of our inference above must be somehow wrong.

HIGHER-ORDER SIMPSON'S PARADOX

This paradox seems to be simply solved by the process of normalisation, which makes denominators equal. For instance, we can make the denominator for each female and male by 200 which we can revise using the same data as in Table 1 as follows:

TABLE 2

	female		*male*		*female & male*	
	ca.de	*no ca.de*	*ca.de*	*no ca.de*	*ca.de*	*no ca.de*
more than 5 mSv	67	133	133	67	200	200
less than 5 mSv	55	145	129	71	184	216

In this case, Simpson's paradox does not arise. The probability of dying of cancer in the case of people exposed to more than 5 mSv per year is higher than in the case of people exposed to less than 5 mSv per year.

However (again), Simpson's paradox can arise at a higher order. The same data as Table 1 can be sorted through a different categorisation, namely, people aged over 50 and people aged under 50.

TABLE 3

	over 50		*under 50*		*total*	
	ca.de	*no ca.de*	*ca.de*	*no ca.de*	*ca.de*	*no ca.de*
more than 5 mSv	10	20	30	30	40	50
less than 5 mSv	20	15	85	75	105	90

In this case, as opposed to Table 1, the probability of dying of cancer in the case of people exposed to less than 5 mSv is greater than in people exposed to more than 5 mSv. Simpson's paradox does not arise here, although we could theoretically suppose that this consists of precisely the same data as the case shown by Table 1.

In addition, this situation in Table 3 is the same even if we normalise it by making the denominator 200.

TABLE 4

	over 50		*under 50*		*total*	
	ca.de	*no ca.de*	*ca.de*	*no ca.de*	*ca.de*	*no ca.de*
more than 5 mSv	67	133	100	100	167	233
less than 5 mSv	114	86	106	94	220	180

In this normalised table, as opposed to Table 1, the probability of dying of cancer in the case of people exposed to less than 5 mSv is greater than people exposed to more than 5 mSv. That is to say, Tables 1 and 3 are contradictory with regard to whether Simpson's paradox arises or not, although the data are exactly the same. Additionally, Tables 2 and 4 are contradictory, although the data are exactly the same. This phenomenon can be called a higher-order Simpson's paradox. We are in complete darkness concerning probabilistic causality. (See Malinas 2003: 169–70).

Of course, philosophers and statisticians neatly arrange their ideas through taking confounding variables into account to avoid Simpson's paradox. However,

unfortunately, as far as I understand, it is ultimately impossible to completely eradicate the possibility of Simpson's paradox arising. Nevertheless, we cannot doubt that when we use causal concepts, we rarely consider the notion of necessity; rather we are dealing with uncertainty. This uncertainty absolutely conforms to the notion of probability. That is to say, we cannot distance ourselves from the idea of probabilistic causality, even though we must admit that the idea of probabilistic causality certainly ends with being involved in a chaotic situation.

A CONCLUSION

How should we deal with this situation? We collect statistical data to find the causal relation between exposure to radiation and cancer death. We should do our best to collect data, given the physico-metaphysical nature of causation. However, theoretically speaking, as the possibilities of common cause or Simpson's paradox show, we cannot be perfectly convinced of our conjecture about the causation based only on research at the physico-metaphysical level. We should make decisions at some point about whether exposure to low-dose radiation can cause cancer or not through a process of social agreement or something such as court proceedings. This is not a deviation from our original aim of finding causation to different contexts external to our aim. Instead, it is a way of establishing our causal judgments, as this route to decision making corresponds precisely to the normative nature of causation, probably and often involving an approach to how to treat the problem of responsibility.

We should always take the hybrid nature of causation seriously when we consider causal relations in ethical issues. (I want to assert that the same is true of any causal judgment in principle, even if the degree by which the normative nature becomes conspicuous in the case of purely scientific causal judgments could be lower than that in the case of ethical issues.). We should not suppose that we could finally solve the problem of causal relations purely through physico-metaphysical investigations (although of course such investigations are indispensable). I conclude my article with this modest warning.

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