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ON CAUSALITY AND CONCEPT RELATIONSHIPS

> *'Tis sufficient to observe that there is no relation, which produces a stronger connexion in the fancy, and makes one idea more readily recall another, than the relation of cause and effect betwixt their objects.* (David Hume[i])

1 Introduction

The subject of this paper is causality and the conceptual relations that stem from it. My purpose is to discuss the possibilities of applying some aspects of the theory of causality in terminological analysis. I chose this theme because during this summer I have been working with it as part of my forthcoming Ph.D. dissertation focusing on the theoretical aspects of concept systems and concept relationships.

What makes causality especially interesting is that it has not yet been sufficiently dealt with in the theory of terminology, in spite of its importance for human thinking and understanding of the world.

In terminological analysis we are used to ask for example *"What kinds of objects are we dealing with?"* and *"What components does an object consists of?"*. In addition to this, we could also ask *"What caused this phenomenon?"*, or *"What could this phenomenon cause?"*. Causal relations are an important connector between the phenomena and should thus also form a good basis for concept relationships. Though I have been mostly interested in the theoretical side of causality, I have also noticed that in many subject fields there can be found concepts whose relationships are based on causal relations between the corresponding phenomena.

2 The theory of terminology and causal concept relations

In terminological literature causal relationships are often mentioned[ii] or referred to as "other" relationships, but not analysed further. Wüster is one of those who mentions causality but he subordinates it to **relationships of effect** (*Wirkbeziehungen*). So, in his

[i] Hume 1969/1739: 58-59.

[ii] See e.g. Wüster 1974a; DIN 2330-1979; Felber 1984: 129.

Nuopponen, Anita (1994). On Causality and Concept Relationships. In: Draskau & Picht (eds.): *Terminology Science and Terminology Planning, IITF-Workshop on Theoretical Issues of Terminology Science,* 217-230. Vienna: TermNet.

texts, there appear two main concepts of *relationship* that include a causal component: the super ordinate concept called *Wirkbeziehung*[iii] (relationship of effect) or *ursächliche Beziehung* or *ursächliche Zusammenhang*[iv] (causal relationship/connection) and the subordinate concept called *Kausalität*[v] (causality). Other relationships of effect are relations referred to by Wüster 'tooling' and 'descent'. Tooling has to do with an instrument and its use and descent either with the relationships between the stages of development of an art (phylogenetic relation) or an individual (ontogenetic relation) or the relationships between different generations (genealogical relation) or different stages of substances.

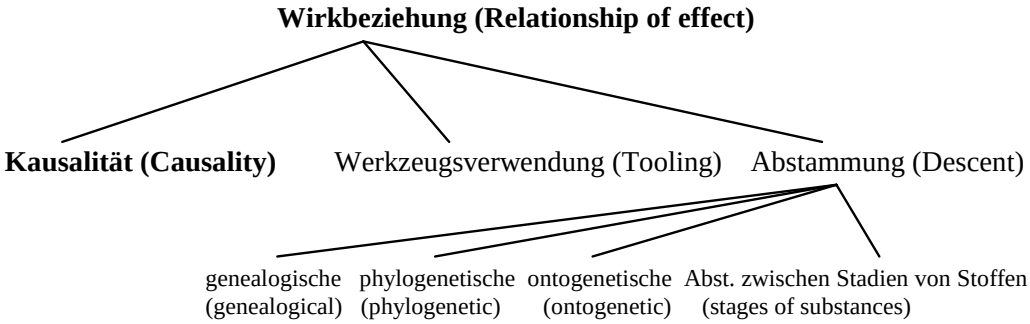

Fig. 1. Relationships of effect by Wüster (1974 b: 263)

Wüster, as with the other terminological sources[vi], does not explain what he means by "causality", except that it is the relation between concepts referring to cause and its effect. The questions which have been bothering me are: how to define the causality, what is actually the cause and what is the effect, are they things or actions and how to apply it in terminological analysis.

3 The concept of causality in philosophical discussion

In order to be able to discuss the role of causality in the theory of terminology in greater detail, it is, in my mind, necessary to trace briefly the history of the concept of causality.

The basic idea of causality could be expressed by saying that *"x causes y"*, which makes the causality look simple. But as Bagozzi (1980: 29) expresses the situation:

> *"the concept* [of causality] *defies simple representation, and it has provoked considerable controversy as to its nature and role in scientific inquiry"*.

[iii] Wüster (1974a)

[iv] Wüster 1974b; Wüster 1979/85,

[v] Wüster 1974b

[vi] NORDTERM 1989:15; Felber & Budin 1989; Sanastotyön käsikirja; DIN 2330

The concept of causality has been discussed through the centuries or, rather for a couple of thousands of years, by philosophers and scientists. And the word 'cause' is used for many different concepts by them. The Finnish philosopher von Wright[vii] states that

> *"not only are 'causes' in human affairs very different from 'causes' of natural events, but within the natural sciences as well causality is not a homogenous category"*

According to the modern conception, both the cause and the effect are actions or events, but if we go back to Plato and Aristotle we will see that it has not always been so. These antique concepts are not at all indifferent for the theory of concept relationships, though we might not call them 'causality'. As I will show, they mostly have their counterpart or some function in terminological analysis.

3.1 Aristotelian causes

Aristotle[viii] distinguishes between four types of causes: formal cause, material cause, final cause and efficient cause. By the **material cause** Aristotle (1970: 179) means the material from which something is generated, manufactured; e.g. *silver* for a *bowl*. Also *sheet metal, glass, leather* etc. can thus be considered as material causes for a *car*. According to Wüster's classification the relationship between concepts referring to an object and the material is a non-hierarchic material-object relationship. In Wüster's classification it is one of the contiguity relationships, while causality belongs to the sequential relationships.

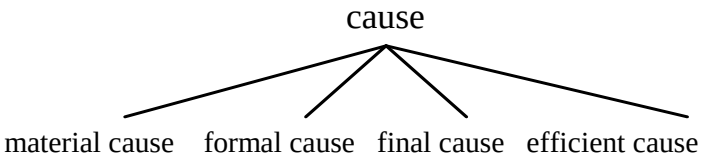

Fig. 2. Causes by Aristotle (1987: 23-24, 113)

The **formal cause** defined by Aristotle again refers to the form, structure and design of the thing or its concept or even its super ordinate concept (Aristoteles 1970: 180). In the theory of terminology we would talk about logical concept relations or a genus-species relationship, and partitive concept relationships or whole-part relationships.

[vii] von Wright1971: 36

[viii] Aristoteles 1987: 23-24, 113.

The **final cause** according to Aristotle (1970: 180) is the purpose or end for which something is done. As an example he cites the *health* as a cause to the *walking*, i.e. our desire to retain our health makes us walk. Aristotle continues that besides walking, there are other means to gain health, for instance *diet, medicine* and *instruments*. This means that he regards an action or an instrument or another means as an effect.

Instead of causality it is more usual to talk about teleology in this case, because according to the modern conception the cause precedes its effect in time. In the teleological explanation phenomena are explained by means of ends or aims, intentions or purposes[ix], as Aristotle does here. In Wüster's classification we find the conceptual relation of tooling - a relationship between concepts referring to a tool and its use - which could be near the Aristotelian final cause.

The **efficient cause** is defined by Aristotle (1987: 115) as the source of change or its cessation. According to him, the cause of the product or of the change, could be either the one that produces or changes something, or his activity. So, an *adviser* could be considered as the efficient cause to a piece of advice and the *father* of his *child* and the activity of a *sculptor* of a *sculpture* (Aristoteles 1987: 115).

type of cause:	example: car[x]	example: book[xi]
material cause	the material components: sheet metal, glass, leather ...	paper, cloth (for covers), thread, ink
formal cause	design, parts of the car model, standards	leaves, pages, covers etc. form
final cause	transporting goods and passengers	reading, entertaining, teaching
efficient cause	production, manufacturing by the workers, engineers, machines	author, typographer, printer, editor; printing and binding machines; writing, printing, editing etc.

Fig. 2. Aristotelian causes and examples

In some terminological sources (DIN, NORDTERM) there is to be found a conceptual relation called the 'genetic relation', which refers to the relation between the producer and the product, thus being a counterpart of the Aristotelian efficient cause. But the Aristotelian efficient cause is a much wider concept, and covers even the relation of causality in Wüster's classification, as well as a part of Wüster's descent.

[ix] Dictionary of Philosophy 1984: 350.

[x] see Menne 1984:106.

[xi] see ibid.

Aristotle's concept of efficient cause has endured[xii] and later on it has been divided into **agent causality** and **action causality**[xiii], the lather one representing the modern concept of causality.

3.2 Action as the cause

The modern concept of causality related to the idea of action or event is largely influenced by the thoughts of the British philosopher David Hume (1711-1776)[10]. He (1969/1739: 58) considers the relation of cause and effect to be the strongest connection between the objects that make our imagination to run from one idea to another - the others being resemblance, contiguity in time or place. Wüster (1974a: 85) also refers to Hume and says that

> *"Für die Terminologie empfiehlt es sich, hierin, Hume zu folgen und von den reinen Nacheinander-Beziehungen die ursächlichen Beziehungen zu unterscheiden"* (Wüster 1974a: 94).

He thus recommends that we should do like Hume and distinguish the pure temporal relations from causal relations. In other ways too, Wüster follows Hume and in his classification of concept relationships distinguishes between logical relations, contiguity in place and time and relations of effect.

In causal relationships there exists a strong temporal element, but in spite of that we are able to distinguish between causal and pure temporal relationships. For instance *day* and *night* follow each other as do the *strophes* in a poem or the *movements* in a symphony without the one being a cause of the other (Regnéll 1982: 55) - even though there lies a causal relationship behind the whole, but not between the members of the relationship. Although time is an important component of the causation it cannot be considered the only explanative factor (see Wright 1971: 43)

According to Hume, who regarded causes as changes in events, or processes instead of things[xiv], any causal relation has at least the following elements (1969/1739: 123ff., 223f.):

a) Firstly, contiguity in time and place: for instance when a moving billiard ball hits another and sets it in motion
b) Secondly, temporal priority of cause and effect: e.g. the motion of the first ball causes the motion of the other ball
c) And finally, necessary connection: i.e. everything like the cause, always produces something like the effect.

[xii] Fjelland 1987: 113
[xiii] Niiniluoto 1983: 237
[xiv] Bagozzi 1980: 4f.

Hume stirred up the question of causation and since then it has been "something of a problem child of epistemology and the philosophy of science" as von Wright (1971: 35) expresses it. There have been many efforts to show that Hume was wrong and some philosophers have even denied the importance of the idea of causation for the science.[xv] Anyhow, the concept of cause connected with the idea of action, as von Wright remarks, "... seems largely to figure as a prototype for the idea of cause in the discussions of philosophers about universal causation, determinism versus freedom, interaction of body and mind, etc." (von Wright 1971: 36f.)

3.3 Events as producing causes and facts as explanatory causes

Mackie (1974: 248), a British philosopher (d. 1981)[xvi], also joins in the discussion about the kind of entities involved in causal relations. He points out that "philosophers have long been inclined to speak of one *event* causing another", e.g. the double assassination at Sarajevo as a cause of the First World War. According to Mackie, the cause can, besides being an event also be a fact. As an example he gives the event of the hammer's striking the chestnut, which he describes as the **producing cause** of the chestnut's change of shape. The **explanatory cause** is, however, "the fact that there was a blow of at least such-and-such a momentum" (Mackie 1974: 265).

Mackie (1974: 265) maintains that in order to be able to think and talk about causal relations, we have to recognise and distinguish producing causes, i.e. events as causes, and explanatory causes, i.e. facts as causes. As an example of producing and explanatory causes one could take causes of an allergic reaction. The producing cause is the exposure to an allergen and the explanatory cause is the fact that the person is already allergic (*allergen* & *allergy/allergic -> allergic reaction*).

Mackie is one of the critics of Hume. He asks if it actually is necessary that the cause and effect must be contiguous in space and time and the cause prior to the effect as Hume maintains. "Are there not causes which are simultaneous with their effects, and might there not conceivably be causes which succeed their effects?" "... are there not causal sequences which nevertheless are not regular... etc."

3.4 Necessary and sufficient causes

Mackie (1974: 4) sees the humean concept of causality as especially problematic when we are dealing with "necessary causes, sufficient causes, necessary and sufficient causes,

[xv] "Many efforts have been made to show either that Hume's view of causation was mistaken [...]. These troubles are probably one of the reasons why some philosophers have insisted that the idea of causation plays only an insignificant role in science and may eventually be exorcised from scientific thinking altogether." (von Wright 1971: 35)

[xvi] Mackie 1974: 4

combinations of causal factors, counteracting causes, a plurality of alternative causes, causal over-determination, and so on", because these will be, according to him, "entirely neglected if we speak just of regular succession".

Not everybody has been contented with the concept of *cause* and e.g. Russell[xvii] suggested that instead of causes one should start talking about **functions** in the philosophy of science. Von Wright (1971: 38) remarks that a similar claim could be made for the concept of **condition**[xviii] and discusses cause and effect in terms of conditionship. Von Wright (1971: 39f.) finds the theory of condition concepts helpful for distinguishing a variety of causal factors and wonders why this theory and its applications have not been further developed and studied. Mackie at least has taken up this discussion[xix].

This is also something that interests me when I think about systems of concepts, where concepts are connected with causal relationships: not all the relationships are similar and not all of them are sequential, but we can also distinguish co-ordination.

It is usual to distinguish between **necessary** and **sufficient** causes or conditions in the philosophy of science[xx]. In the following I shall use the concept of cause. Necessary causes are those which are needed to produce the effect and sufficient causes are those which are alone able to produce the effect. In contrast, there are **insufficient** and **unnecessary** causes. When we combine the different conditions, we shall have the following four possibilities:

	sufficient	insufficient
necessary	A. the only cause, a monolithic cause (is capable of causing the effect alone and is the only cause able to cause this effect)	C. is necessary, but needs some helping factors, conditions or coefficient cause, is not enough by itself (-> complex sufficient cause: conjunction of phenomenon)
unnecessary	B. an alternative cause, "monolithic" (is capable of causing the effect alone, but is not the only possible cause: disjunctive causes) (-> complex necessary condition: disjunction of phenomenon)	D. not sufficient alone, needs contributory causes not the only cause, an alternative cause

Fig. 3. Combinations of different types of causal conditions

What I find most interesting are the causes that are sufficient and unnecessary, i.e. causes that are able to produce the effect by themselves, but are not the only causes for the particular effect. This leads to a plurality of causes, where the causes are alternative.

[xvii] According von Wright 1971: 38

[xviii] In addition to necessary and sufficient conditions von Wright (1971: 38) distinguishes between secondary concepts of **contributory conditions** and **substitutable requirements**, which refers to co-operating causes and alternative causes.

[xix] Mackie (1965). Causes and Conditions. In: *American philosophical quarterly.*

Mackie (1974). *The Cement of the Universe. A Study of Causation.* Oxford: Clarendon Press.

[xx] von Wright 1971: 38; Mackie 1974

This is called 'disjunction'[xxi]. Another interesting case is when the cause is necessary, but insufficient. This leads to a situation where we have a complex of co-operating causes. This is called 'conjunction'[xxii]. I shall soon return to these concepts.

4 Applications of causality in the theory of terminology

I have made some efforts to apply causal theories in terminological theory and I shall present here some of my suggestions. I start from one of Wüster's classifications, where he divides conceptual relations into logical and ontological and the latters into contiguity and relationships of effect.

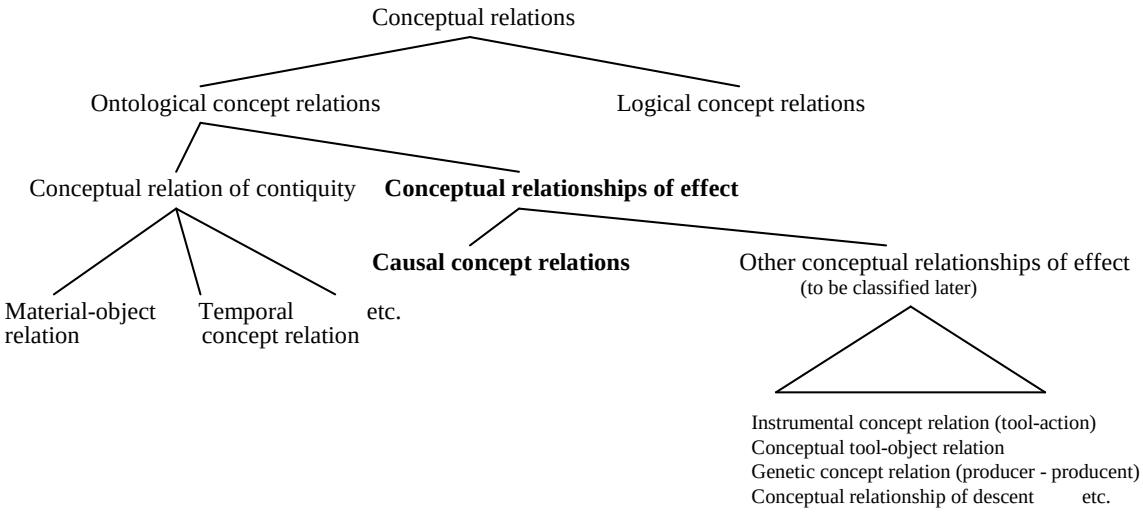

Fig. 4. A preliminary classification of conceptual relations

Under contiguity Wüster has for instance the material-object relation. If we think of the Aristotelian material cause, this relation type could also be classified as a type of relation of effect. Under the relationships of effect I place a list of relations which I am not going to classify more accurately in this context, but shall return to them in my Ph.D. dissertation.

Here I am more interested in causal concept relations, which I subordinate to the relationships of effect and define as conceptual relations based on causation. Causation and causality are here understood in terms of the philosophy of the science of today, i.e.

[xxi] von Wright 1971
[xxii] Ibid.

as the "relationship between two events or states of affairs such that the first brings about the second" as a dictionary of philosophy[xxiii] defines causation.

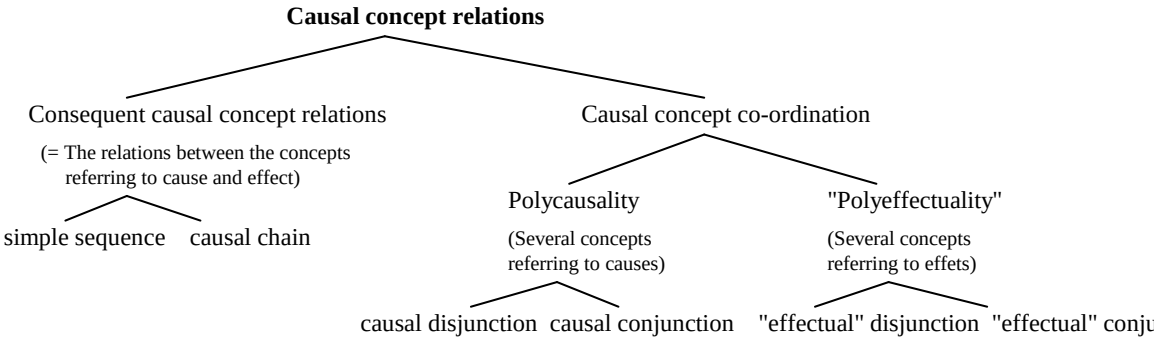

Fig. 5. Causal concept relations

In my classification (fig. 6), the main distinction is made between the **consequent** relations and **co-ordination**. Consequent relations exist between concepts that refer to cause and effect, while co-ordination exists between the concepts that refer either to causes or to effects. Consequent causal relations can form simple concept sequences, which consist only of two concepts, the one referring to the cause and the other to the effect; e.g. [exposure to] *moisture -> corrosion*. Simple sequences can be connected in order to form causal chains; e.g. [exposure to] *moisture -> corrosion* -> [occurrence of] *pits* or *holes*. In the causal chains the first effect becomes the second cause, etc.

Causal concept co-ordination can be divided into what I call preliminary "polycausality" and "polyeffectuality". "Polycausality" is a relation between concepts that refer either to alternative causes (disjunction), e.g. [exposure to] *moisture* or [to] *chemicals -> corrosion*, or to coefficient causes (conjunction), e.g. [to be] *allergic* & [exposure to an] *allergen -> allergic reaction*. "Polyeffectuality" is a relation between concepts that refer either to alternative effects, e.g. *accident -> death, to die* or to *suffer a bodily injury* or to *be crippled* or to *be bruised*, or to co-occurring effects.

This classification is only the beginning and there is a lot of work to be done in this area. I shall continue to do research on this subject.

[xxiii] Dictionary of Philosophy 1984: 58.

5 Conclusions

As we have seen, the concept of causality is described in many different ways in the history of philosophy and if we look at the applications in different sciences we should find additional definitions. In many subject fields causality is an important factor, and finding out causes and effects is essential for instance for medical science, technology etc.

It is the task of the various sciences is to discover particular causal relations and causal laws. In terminological research we could take advantage of the information of these causal structures in the subject fields we investigate. These structures can be used to organise the concepts and other terminological knowledge as well as to define the concepts etc.

In order to be able to do this, however, we need general knowledge about causality and how it works. Here we are assisted by philosophy because, as Mackie (1974: 1 [xxiv]) defines it, the task of philosophy is to determine "what causal relationships in general are, what it is for one thing to cause another, or what it is for nature to obey causal laws". What I see as my task or our task as terminology researchers is to adjust this knowledge to suit for the terminological purposes, i.e. to function and serve as the means of finding out the particular causal structures in the subject fields and "translate" them into terminological representation.

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[xxiv] "It is, of course, part of the business of the various sciences to discover particular causal relationships and causal laws; but it is part of the business of philosophy to determine what causal relationships in general are, what it is for one thing to cause another, or what it is for nature to obey causal laws. As I understand it, this is an ontological question, a question about how the world goes on. (Mackie 1974: 1)

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