

Types of causal relations: a survey

Sanae Tamura,^{*} Yurie Hara,[†] Youngju Kim,[‡] and Hiromu Sakai[‡]

1 Introduction

This is a survey article on the taxonomy of causal relations and their linguistic realizations. Causal relations serve as a basis for various intellectual activities of human beings, e.g. inference, decision making, and so on. At the same time, natural languages have various ways to express causal relations, and these expressions draw much attention, not only from linguists, but also from philosophers and cognitive scientists. Many previous studies argue that causal statements are not homogeneous, that is, we require several kinds of causal relations in the (linguistic) ontology. The classifications seen among these studies are, however, not the same. This survey provides an overview of previous analyses.

First, we discuss metaphysically driven distinctions between causal relations. Section 2 summarizes Davidson's (1967) classical work, which claims that causal relations are relations between concrete objects, namely, events. In section 3, we review several studies which argue that abstract facts, not events, may function as causal relata. Then, in sections 4 through 6, we focus on linguistically driven distinctions: In section 4, CAUSE VS. CONTROL in Japanese causative verbs, in section 5, *direct* vs. *indirect* causations, and, in section 6, *volitional* vs. *non-volitional* causations. Section 7 summarizes the survey.

2 Davidson 1967: causation vs. causal explanation

Donald Davidson is one of the most influential scholars in the literature of causation. In Davidson (1967), he discusses singular causal statements such as 'The flood caused the famine' and 'The burning of the house caused the roasting of the pig', and their logical forms.

^{*} Kyoto University

[†] City University of Hong Kong

[‡] Hiroshima University

Davidson's main claim is that causations are relations between extensional objects, namely events. Davidson argues against Mill (1886) that causal relations are conditionals. Moreover, Mill regards causes and effects as sentences (or facts), thus the logical form of the sentence like (1) is like (2).

- (1) The short circuit caused the fire.
 (2) *The fact that there was a short circuit caused it to be the case that there was a fire.*

Davidson (1967) proves that (2) should not be the logical form of (1). Davidson's proof is a so-called *slingshot argument*. It depends on the assumption that all true/false sentences denote the same object, namely, the truth value 1/0, respectively. Moreover, if two expressions are co-extensional, the substitution of one for the other does not change the truth-condition of the sentences in which the expressions are included. Therefore, it is predicted that we could substitute other propositions with the same truth value for the propositions *there was a short circuit* or *there was a fire*, without changing the truth value of the sentence (2). It is obvious, however, that the prediction fails. Even if both *there was a short circuit* and *there was a car accident* are true, (3) does not have the same truth-condition as (2).

- (3) *The fact that there was a car accident caused it to be the case that there was a fire.*

Therefore, (2) is not an appropriate logical form.

Based on this proof, Davidson (1967) argues that causations are relations between events. In Davidson's view, (1) can be represented by (4).^{*1}

- (4) *te.[short-circuit(e)] causes te.[fire(e)].*

*1 A causal statement should be supported by a corresponding causal law. From this law and the premise that the events referred to exist, we are to infer the causal statement. According to Davidson (1967), the causal law behind (4) is as in (i).

- (i) $\forall e, \forall n. [(short-circuit(e) \& t(e) = n) \rightarrow \exists! f. [fire(f) \& t(f) = n + \varepsilon \& C(e, f)]]$, and
 $\forall e, \forall n. [(fire(e) \& t(e) = n + \varepsilon) \rightarrow \exists! f. [short-circuit(f) \& t(f) = n \& C(f, e)]]$

The variables e and f range over events, n ranges over numbers. $C(e, f)$ represents ' e causes f ', and t is a function that assigns a number to an event, indicating the time at which the event occurs.

Since the event in which there was a short circuit is distinct from the event in which there was a car accident, the substitution of one for the other should change the truth-condition of the whole sentence. So (4) correctly predicts that substitution of the clauses in (1) changes the truth-condition of (1).

There are, however, sentences which cannot be explained by Davidson's analysis. In examples with negation such as (5), the causations seem to be expressed as relations between facts.

- (5) a. The collapse was caused, not by the fact that the bolt gave way, but by the fact that it gave way so suddenly and unexpectedly.
b. The fact that the dam did not hold caused the flood.

Davidson regards sentences like (5) not as singular causal statements, but as causal explanations. His remark on this point is as follows:

[...] in addition to, or in place of, giving what Mill calls the 'producing cause', such sentences tell, or suggest, a causal story. They are, in other words, rudimentary causal explanations. Explanations typically relate statements, not events. [...]

(Davidson 1967: 161)

To summarize, Davidson (1967) argues that there are at least two types of statements which refer to causal relations: singular causal statements and causal explanations.

	Relata
Singular causal statements	events
Causal explanations	statements

TABLE 1. Davidson's (1967) view

3 Event causation and fact causation

Though Davidson (1967) has been influential, some scholars do not agree with Davidson on the kinds of causal relata. Alternatives for causal relata are, for example, *facts* (Bennett 1988, Mellor 1980), *features* (Dretske 1970), *tropes* (Campbell 1990), *states of*

cles, and prepositions.*³

Vendler points out that verb-like gerunds can appear as objects of verbs such as 'deny', 'forget', 'surprise', and as subjects of adjectives such as 'probable', 'possible', and so on, and that those are the positions in which propositional objects occur. On the other hand, noun-like gerunds may appear as objects of verbs like 'watch', 'listen to', 'occur', 'take place', and as subjects of adjectives such as 'slow', and 'sudden', which are the positions where event-like objects appear. Based on this distribution of the two types of gerunds, Vendler argues that a verb-like gerund denotes a fact, whereas a noun-like gerund denotes an event.

Further, Vendler (1962, 1967) observes that it is verb-like gerunds, not noun-like ones, which appear in the subject position of 'cause'.

- (8) a. His having crossed the Rubicon caused the war.
b. His not being able to stop the cavalry caused the defeat.

(taken from Vendler 1967)

In (8), the verb-like gerunds 'his having crossed the Rubicon' and 'his not being able to stop the cavalry' appear as the subject of the verb 'cause'. Therefore, Vendler concludes that causes are facts.

Vendler also argues that, unlike *X is the cause of Y* or *X causes Y*, the statement *Y is the effect of X* takes events in the position of *X*. (9) is less acceptable, because a verb-like gerund occurs as the second argument.

- (9) ?The war was the effect of his having crossed the Rubicon.

(taken from Vendler 1967)

This shows that the different types of 'causal' statements represent the relations between different types of objects, as shown in (6).

Additional evidence for Vendler (1962, 1967) is the distribution of the noun 'cause'. 'Cause' may function as the object of verbs such as 'find', 'deduce', and 'mention', and as the subject of 'indicate', 'lead to', 'obvious', 'probable', and 'unlikely'. These are also the positions where the word 'fact' can appear. In addition, 'cause' cannot occur at a position normally occupied by an event: for example, the subject position of 'has occurred', 'taken

³ Asher (1993) shows the differences between noun-like and verb-like gerunds in much more detail.

place', 'began at some time', and 'lasted for a while'. We cannot substitute the word 'event' for 'cause', so 'cause' does not denote an event.

To summarize, Vendler (1962, 1967) shows that the relations *is the cause of*, *is the effect of* and *is the result of* take different types of argument. Though Vendler admits that all statements with these expressions may be called *causal statements* in a broader sense, he regards 'X is the cause of Y' as the most common causal statement. Based on the distribution of noun-like and verb-like gerunds, he concludes that causes are *facts*, whereas effects are *events*.

3.2 Bennett 1988: event and fact causation

Bennett (1988) argues that there are two types of causation: event and fact causation. (10) shows examples of event causation, and (11) and (12) of fact causation.

- (10) a. The tidal wave caused the collapse of the oil rig.
b. Her fall caused the fracture.
c. The volcanic eruption caused the forest fire. (Bennett 1988, p.21)
- (11) a. His perpetually smoking cigarettes led to his getting cancer.
b. She sneered at him, which resulted in his sulking for a week.
c. One upshot of the wind's starting up when it did was that the fire was driven into the new timber.
d. That I dislike Julius Caesar is a consequence of my having to study it in high school. (Bennett 1988, p.21)
- (12) a. The fire went out because the rain came.
b. In consequence of the rain's coming, the fire went out. (Bennett 1988, p.22)

According to Bennett (1988), the difference between the two types of causation is as follows: in a fact causation statement, if we substitute one verb-like gerund for another, the truth value of the whole statement may change, unless the propositions which the gerunds represent are strictly equivalent. In contrast, in an event causation statement, the risk of changing the truth value is rather small.

Bennett's analysis can explain the difference between (13) and (14). Suppose that Henry fell twenty feet from the rooftop and broke his leg. In this situation, (13a) and (13b) need not have the same truth value, though (14a) and (14b) must have the same

truth value.

(13) Fact causation statements

- a. Because of his coming down from the roof, he suffered a fracture.
- b. Because of his falling twenty feet, he suffered a fracture.

(Bennett 1988, p.24)

(14) Event causation statements

- a. Henry's fracture was caused by his descent from the roof.
- b. Henry's fracture was caused by his twenty-foot fall.

(Bennett 1988, p.24)

This is because the event of his falling is the same event, regardless of the expressions which are used in referring to it, whereas the fact that Henry came down from the roof is not at all the same as the fact that he fell twenty feet (Bennett 1988, p.24).

Just like Vendler (1962, 1967), Bennett (1988) admits causal relations which involve both events and facts; that is, if we use the notation $C(A, B)$ meaning 'there is a causal relation between cause A and effect B', he allows the mixtures $C(f, e)$ and $C(e, f)$, in addition to $C(e_1, e_2)$ and $C(f_1, f_2)$. There are, indeed, some examples representing these mixed (or hybrid, using Vendler's term) types of causal relations.

- (15) a. The divorce resulted from their incessantly quarreling. $C(f, e)$
b. The discovery of penicillin has led to there being more resistant bacteria
than there used to be. $C(e, f)$

(Bennett 1988, p.24)

4 Kageyama 1996: CAUSE and CONTROL

In this section and the following two sections, we discuss three linguistically driven approaches to classifying types of causal relations: namely, (A) CAUSE and CONTROL in Kageyama (1996) (this section), (B) direct and indirect causation (section 5), and (C) volitional and non-volitional causation (section 6).

First, let us focus on Kageyama's (1996) analysis of Japanese causative verbs. Kageyama (1996) motivates a distinction in the types of causation from a linguistic perspective. Kageyama (1996) points out that the "philosophical" approaches treat

causation as a relation between events or propositions. According to Kageyama, however, the Japanese linguistic data suggest that the causer argument of a causal relation should not be limited to events or propositions. In particular, Kageyama investigates a morphological alternation between intransitive and transitive verbs in Japanese and argues for a distinction in terms of the agenthood of the causal predicates, i.e., CAUSE and CONTROL.

Compared to English, which has relatively few transitive/intransitive pairs, the Japanese causativization of intransitive verbs into transitive ones seems productive. Japanese has at least two kinds of suffixes which causativize intransitive verbs, *-e-* on the one hand and *-as-* and *-os-* on the other:

- (16) a. *-e-*: tatsu 'stand/be built' → tateru 'build', susumu 'proceed' → susumeru 'bring forward', narabu 'line up (intr.)' → naraberu 'line up (tr.)'
 b. *-as-*, *-os-*: naru 'ring (intr.)' → narasu 'ring (tr.)', tobu 'fly (intr.)' → tobasu 'fly (tr.)', zureru 'go off the track' → zurasu 'displace'
- (taken from Kageyama 1996)

Kageyama shows that *-e-* transitive verbs can only take individuals as their subjects.

- (17) a. {daikusan-ga/*kare-no mochi-ie-ganboo-ga} ie-o
 carpenter-NOM/his have-house-hope-NOM house-ACC
 tat-e-ta.
 stand-CONTROL-PAST
 'The carpenter/his hope for having his own house built the house.'
 b. {kodomo-ga/*densha-no shindoo-ga} ishi-o narab-e-ta
 child-NOM/train's shake-NOM stone-ACC line.up-CONTROL-PAST
 'The child/the train's shake lined up the stones.'
- (taken from Kageyama 1996)

Kageyama analyzes the morpheme *-e-* as a CONTROL predicate. The subject/agent of the CONTROL predicate directly controls the occurrence of the caused event:

- (18) *-e-*: x CONTROL [EVENT ...] (Kageyama 1996, p.141)

A linguistic expression which denotes an event or a proposition cannot be the subject/agent of CONTROL, as seen in (17), because an event/proposition is not an intentional object.

On the other hand, in the case of *-as-* or *-os-*, Kageyama (1996) concludes that the causer semantically denotes an event. It appears that the subjects of the predicates which involve *-as-* or *-os-* can be either individuals or events, as in (19).

- (19) a. {kare-wa/ame-ga} kasa-o nur-as-ita.
 he-TOP/rain-NOM umbrella-ACC wet-CAUSE-PAST
 'He/the rain wet his umbrella.'
- b. {kodomo-ga/hideri-ga} hana-o kar-as-ita.
 child-NOM/drought-NOM flower-ACC die-CAUSE-PAST
 'The child/the drought caused the flowers to be dead'
- c. {titiyo-ga/denwa-no beru-ga} kodomo-o ok-os-ita.
 father-NOM/telephone-GEN ring-NOM child-ACC wake.up-CAUSE-PAST
 'The father/the telephone ring woke the child.'

(Taken from Kageyama 1996)

Kageyama proposes that *-as-* and *-os-* introduce an implicit predicate CAUSE which takes an event as its subject. Hence, the NP *hideri* 'drought' in (19b), which denotes an event, can naturally be the subject of the sentence. When the subject appears to be an individual such as *kodomo* 'child', we can easily construe an associated event, namely an act that the individual brings about, such as 'the child forgot to water the flower'. The sentence structure can be schematized as follows:

- (20) *-as-*, *-os-*: [EVENT X ACT | CAUSE | EVENT ...] (Kageyama 1996, p.139)

In short, Kageyama (1996) makes a distinction between causal relations based on the morphology of Japanese causative verbs. A transitive verb which contains the *-e-* morpheme expresses a CONTROL structure where the subject denotes the intentional agent. The agent directly controls the event denoted by the root verb. In contrast, a transitive verb which contains *-as-* or *-os-* expresses a CAUSE structure where the subject denotes an event which accelerates the inchoative event denoted by the root verb.

5 Direct and indirect causation

In this section, we discuss the distinction between *direct* and *indirect* causation, and see how it affects linguistic phenomena. Many researchers suggest the notion of *directness* plays an important role in natural languages (Wierzbicka 1975, Shibatani 1976, McCawley 1978, Dowty 1979, Gawron 1985, Comrie 1985, Levin & Rappaport Hovav 1994, Wolff

2003, among others).

The fundamental difference between direct and indirect causations is whether there are any intervening events in the causal chain between cause and effect. If there are, it is an indirect causation. Let us look at Wolff's (2003) example in Figure 1.

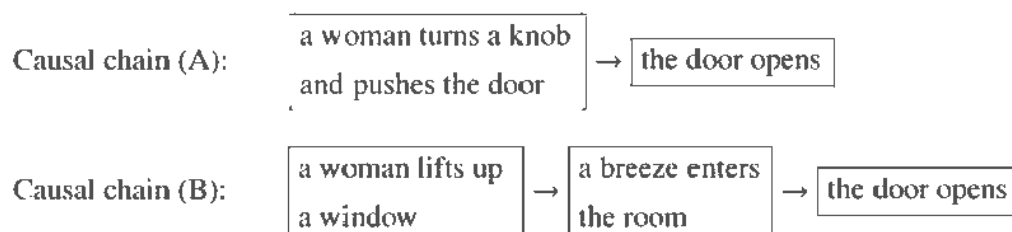


Fig.1 Direct and indirect causation

In causal chain (A), there is no intervening event between the woman's pushing of the door and the door's opening, so it represents a direct causal relation between the two events. On the other hand, in (B), the event of a breeze entering the room intervenes between the event of the woman lifting up a window and the door's opening, thus this is an indirect causal relation.

Many linguistic phenomena can be identified as manifestations of the distinction between direct and indirect causation. For example, the distinction affects the range of events to which a verb phrase can refer: (21a) can refer to the series of events of both situations (A) and (B) in figure 1, while (21b) can be used only in situation (A).

- (21) a. Sara caused the door to open.
b. Sara opened the door. (taken from Wolff 2003, p.2)

(22) shows the same point.

- (22) a. He caused the sheriff to die.
b. He killed the sheriff. (taken from McCawley 1978)

It is often pointed out that the direct-indirect distinction correlates with the distinction between intentional/volitional and non-intentional/non-volitional causation. In fact, some researchers use the terms 'direct' and 'indirect' in order to distinguish between types of causation in terms of volitionality. This use is, however, somewhat misleading, because the two classifications are not always interchangeable. We will discuss this point in the next section.

tion which is akin to that between ‘direct’ and ‘indirect’ cause. From a more general functional point of view, these traditional distinctions can be rephrased in terms of volitionality. Linguistic structures that are typically used to express a (direct) cause may be perceived as expressing a direct relation between causing situation and caused situation without intervention of any volitionally acting being. Constructions that encode (indirect) reasons seem to express a more indirect relation between cause and effect, in which a volitional aspect is more often involved. (Degand 2000, pp.693–694)

It is worth noting that Degand’s (2000) suggestion is somewhat misleading. Though volitionality and directness of causal relation seem to correlate in many cases, the two notions are not interchangeable. The difference lies in the nature of the ‘intervening’ event. For example, the causal chain (B) in Figure 1 represents indirect causation, since there is an intervening event, i.e. the breeze’s entering the room. The causal chain does not, however, represent a volitional causal relation, because there is no recognition of the original cause by any agent.

For a causal relation to be indirect, it is enough that there is some intervening event of whatever type between the cause and the effect. On the other hand, in the case of volitional causal relations, the intervening event needs to involve perception or recognition by an agent, and a decision by him/her.

6.2 Volitionality in Japanese: sentential *koto*-nominals

In this section, we present some data which indicate that volitionality plays a role in Japanese as well.

Unlike Dutch, in Japanese causal statements, there is no lexical marker for the volitionality of causal relations, but we can observe a linguistic manifestation of volitionality in Japanese sentential nominals like (25).⁴

⁴ The difference between the two types of causative constructions in Japanese might be another linguistic manifestation of volitionality. In Japanese causative constructions, as shown in (ii), we can mark the causee both with the accusative marker *-o* and with the dative marker *-ni*. However, if the causee cannot have the intention to stand up, it is unacceptable to mark the causee with *-ni* (Shibatani 1990, Tsujimura 1996, among others).

(ii) a. Naomi-wa Ken-{o/ni} tat-asc-ta.
Naomi-TOP Ken-{ACC/DAT} stand-CAUS-PAST

- (25) akuserupedaru-ga koshoo-shita koto
 gas.pedal-NOM break-did FN
 '(the fact) that the gas pedal broke'

In (25), the noun *koto* is attached to the sentence 'the gas pedal broke'. *Koto* is often called a 'formal noun', that is, a noun which carries little semantic content. We will call this construction the 'sentential *koto*-nominal'.

A sentential *koto*-nominal may appear in a causal statement, referring to the cause. See (26) and (27).

- (26) akuserupedaru-ga koshoo-shita koto-ga jiko-o hikiokoshita.
 gas.pedal-NOM break-did FN-NOM accident-ACC caused
 'That the gas pedal broke caused the accident.'
- (27) akuserupedaru-ga koshoo-shita koto-ga shoohisha-no toyota-banare-o
 gas.pedal-NOM break-did FN-NOM consumers-GEN Toyota-leave-ACC
 hikiokoshita.
 caused
 'The fact that the gas pedal broke caused the consumers to leave Toyota.'

(26) refers to a non-volitional causal relation, and (27) refers to a volitional causation. In these sentences, there seems to be no difference between the two types of causal relations.

The volitionality of causal relations, however, affects the availability of modal elements in sentential *koto*-nominals.

- (28) *akuserupedaru-ga koshoo-shita **kamoshirenai** koto-ga jiko-o
 gas.pedal-NOM break-did maybe KOTO-NOM accident-ACC
 hikiokoshita.
 caused
 *'That the gas pedal might have broke caused the accident.' (Non-volit.)
- (29) akuserupedaru-ga koshoo-shita **kamoshirenai** koto-ga shoohisha-no
 gas.pedal-NOM break-did maybe KOTO-NOM consumers-GEN

'Naomi made Ken stand up.'

- b. Naomi-wa kanban-{o/*ni} ta-ase-ta.
 Naomi-TOP signboard-{ACC/DAT} stand-CAUS-PAST
 'Naomi made the signboard stand.'

toyota-banare-o hikiokoshita.

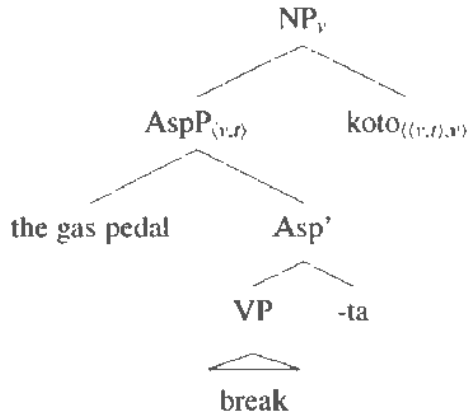
Toyota-leave-ACC caused

‘The fact that the gas pedal might have broken caused the consumers to leave Toyota.’ (Volit.)

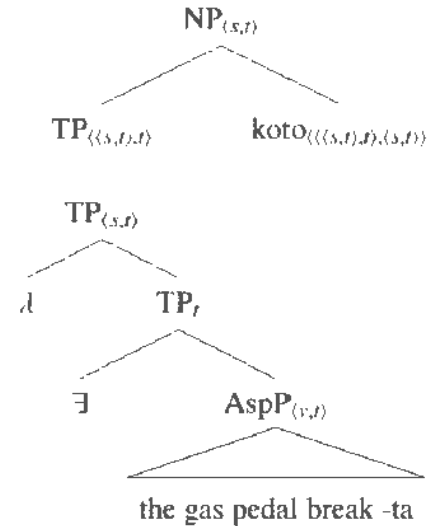
When a sentence refers to a non-volitional causal relation like (28), a modal such as *kamoshirenai* cannot appear in the sentential *koto*-nominal. In contrast, in a volitional causal statement like (29), the modal can appear in the *koto*-nominal.

In Hara et al. (2010a, 2010b), we argue that the two types of causal statements, i.e. volitional vs. non-volitional ones, differ in the syntactic structures of and the semantic objects referred to by the sentential *koto*-nominals. According to our analysis, in a sentence referring to a non-volitional causal relation, *koto* takes AspectP (30a), and AspectP-*koto* denotes an event. On the other hand, in a sentence referring to volitional causation, *koto* takes TP (30b), denoting a proposition.

(30) a.



b.



The availability of modals depends on the structure of the *koto*-nominal. The modal *kamoshirenai* represents a diamond operator $\diamond$, which takes an intensionalized proposition $\wedge p$ and returns a proposition $\diamond \wedge p$. That is, the operator is of the type $\langle\langle s, t \rangle, t\rangle$. In (30a), there is no node of the type $\langle s, t \rangle$ with which *kamoshirenai* can be merged (see Hara et al. 2010a,b for details).

7 Summary

In this survey, we have discussed several studies which classify various types of causation. Some studies make metaphysically driven distinctions and others are linguistically driven. As for Davidson's, Vendler's, Bennett's, and Kageyama's analyses, the classification of causal relations depends on their causal relata. The philosophers discuss whether the causal relata are events or facts. Kageyama (1996) focuses on causative verbs and proposes that there are two types of causal relations: one, *CAUSE*, is the relation between events, and the other, *CONTROL*, is that between an individual and an event.

In sections 5 and 6, we reviewed two different classifications. These classifications are based on types of causation, namely, whether there is an intervening event between the cause and the effect. If there is any intervening event, the causation is indirect, and if not, it is direct causation. On the other hand, if someone's recognition of the cause intervenes between the cause and the effect, the causal relation is volitional. In non-volitional causation, there is no recognition involved. Though the two classifications sometimes overlap, they are by nature different notions.

The classifications above say little about the relation between the types of causal relata and the types of causal relations. In section 6.2, we gave an analysis of the correlation between them. When a cause denotes a proposition, the causation is interpreted as volitional; whereas when the cause denotes an event, the causation is non-volitional. Further investigation of the correlation between these classifications is needed.

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哲学的・言語学的研究における因果関係の分類

田村 早苗 原 由理枝 金 英周 酒井 弘

歌

本研究ノートでは、先行研究で提案されてきた因果関係の分類について概観し、関係する言語現象についてまとめる。哲学、言語学両分野の研究において、因果関係をいくつかの種類に分けられることが提案されている。本論ではそのうち4つの分類基準について論じる。すなわち、(A) 因果関係の担い手が事実・命題であるか出来事であるか、(B) 結果を引き起こすものが個体であるか出来事であるか、(C) 原因と結果の間に別の出来事が介在しているか否か、(D) 原因と結果の間に、何らかの主体による原因の認識が介在しているか否か、の4点である。

2, 3 節では (A) の基準にかかわる先行研究をまとめた。まず 2 節では、因果関係に関する古典的研究として、Davidson (1967) の因果言明 *causal statement* と因果的説明 *causal explanation* の分類について述べた。前者は出来事間の関係を表すが、後者は事実にかかわるものである。その後 3 節で、出来事間の因果と事実間の因果の両方を認める研究として、Vendler (1967) と Bennet (1988) を取り上げた。4 節では、(B) の観点による分類として、日本語の使役動詞を分析した影山 (1996) について見た。影山は、使役動詞の形態意味論的分析のための概念として、因果関係を CAUSE と CONTROL の 2 種類に分けることを提案している。

5 節と 6 節は原因と結果の間の介在物に注目した分類を扱った。5 節は (C) の観点について、直接因果 *direct causation* と間接因果 *indirect causation* という分類を取り上げ、因果関係の違いが言語現象に影響する場合を見た。最後に 6 節では、(D) の基準による分類を論じた。原因と結果の間に認識が介在する場合は意志的因果 *volitional causation*、介在しない場合は無意志的因果 *non-volitional causation* とした上で、日本語の (1) のような例にもこの分類が関わることを論じた。

- (1) a. アクセルペダルが故障したことが事故を引き起こした。(無意志的因果)
b. アクセルペダルが故障したことが消費者のトヨタ離れを引き起こした。
(意志的因果)

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