Logical Sequence Relations in the Framework of Arguments

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1. Introduction

Semantic relationships between clauses and groups of clauses, or sentences or groups of sentences are referred to as Clause Relations by scholars, such as Eugine Winter and his associates. The CAUSE-EFFECT relation, for example, is a type of Clause Relation, and the two units between which this relation is established are respectively referred to as the CAUSE member and the EFFECT member. Clause Relations are classified into two general types: the Matching Relation and the Logical Sequence Relation. In this paper, my interest is mainly in the latter although the former will also be discussed in due course. Winter defines the notion of the Logical Sequence Relation as:

> a general term for clauses which are sequentially related by the semantics of a deductive reasoning which implies the logic of time sequence or by time sequence itself. In logical sequence the meaning of the sequence itself is crucial to identifying the relation.
>
> (Winter 1982: 88)

In this definition the term *clause* must be interpreted in a much broader sense than usual, and it includes the unit of a sentence and a group of sentences. The ambiguity of this kind seems to be intrinsic to any definition of this sort which tries to view a semantic property as unique to a particular grammatical unit. This point leads to the criticism of Winter's definition by Winifred Crombie who writes as follows:

> Winter does not seem to accept, presumably because he is not really talking in semantic/propositional terms, that a clause relation may be

found within a single clause. (Crombie 1985: XV)

To support her view of a clause relation within a single clause, Crombie presents examples such as:

Her intervention caused his defeat. (ibid. Xii)

Whether it is between two clauses or two propositions which the relation holds, here I am more interested in another part of Winter's definition, that is, *the semantics of a deductive reasoning which implies the logic of time sequence.* The main purpose of this paper is to clarify this part of the definition in terms of four types of Logical Sequence Relation: CAUSE-EFFECT, CONDITION-CONSEQUENCE, MEANS-PURPOSE and CONCESSION-CONTRAEXPECTATION. All the examples used in this paper are cases in which semantic relations are established between a subordinate clause and its main clause. This choice, however, has been made simply for the sake of convenience; in complex sentences the type of the Logical Sequence Relation holding in the particular case is explicitly signaled by the presence of subordinators, such as *because, if, although,* and *in order that.*

2. The underlying premise of an argument

The necessity of clarifying the part of Winter's definition mentioned above arises because he does not provide a satisfactory explanation of what he means by *the logic of time sequence* or seems to have taken it for granted. Compare the next two sequences:

(a) There is nowhere else for them to go, and still be under supervision. They stay in their cells for most of the day as well as the night.
(b) They stay in their cells for most of the day as well as the night. There is nowhere else for them to go, and still be under supervision.
(Winter 1982: 87)

Winter writes that whereas the second sentence in (a), in everyday logical terms, follows from the sense of the first sentence, the second sentence of (b) does not. His explanation is that in (b) we have to infer an inductive reasoning relation for the second sentence in the light of the meaning of the first sentence. What he seems to imply here is that there is an unchangeable logical order between two members which is independent of their representational order in the text. In the present example, the CAUSE member precedes the EFFECT member irrespective of the order in which they are realised in the text.

Although this explanation tells us something about the difference between logical sequence and representational order, it does not seem to be a clear explanation of *a deductive reasoning which implies the logic of time sequence*. The only clue as to the meaning of this notion is his explanation that one member of a Logical Sequence Relation logically follows the other member. However, we cannot be sure about what kind of logic or deduction is being talked about.

A similar problem arises when we see an explanation given by Quirk and Greenbaum of a type of clause relation referred to as *clauses of circumstances* exemplified by the sentence below:

> Seeing that the weather has improved, we shall enjoy our game.
> (1973: 327)

Below is their explanation:

> Clauses of circumstance express a fulfilled condition or (to put it differently) a relation between a premise (in the subordinate clause) and the conclusion drawn from it (in the main clause). (my underline)

The underlined part of this definition seems to correspond to Winter's term for *deductive reasoning*. The similarity between the two definitions is that neither of them explicitly shows the logic which makes the one member of the relation follow the other as its conclusion, though they seem to imply it.

A member of the Logical Sequence Relation which operates as a logical conclusion cannot be deduced from just one premise or the first member of the relation. For the conclusion to be obtained, there must be at least another preceding premise. If one member of the relation is expressed as p and the other as q, one possible argument in which q follows p as its conclusion is:

p → q ... (a) premise
p ... (b) premise
q ... (c) conclusion

(This argument is referred to as Modus Ponen' in logic)

This argument has two premises (a) p→q and (b) p, and (c) q is deduced from them as the conclusion. If the notion of the Logical Sequence Relation is interpreted in the framework of this argument, we can understand the premise (a) as what Winter means by *the logic of time sequence*. As for the other definition by Quirk and Greenbaum, the underlined part should be modified as follows:

> a relation between two premises (one of which is in the subordinate clause while the other precedes it implicitly) and the conclusion which is drawn from them (in the main clause)

Thus, if we were to see some deduction between the two members of a Logical Sequence Relation, it would be necessary to presume the premise (a) p→q which is not linguistically realised but underlies or is implied by the relation.

3. The premise p → q underlying Various Logical Sequence Relations

About the implicit premise (a) p→q, there is one point to be discussed here. Although p was taken to stand for one member of the Logical Sequence Relation and q, the other member in the previous section, this might not be an accurate description. For p and q in the premise (a) seem to be endowed with neither a particular membership meaning, such as CAUSE, EFFECT, CONDITION, and CONSEQUENCE, nor other properties, such as tense and

modality. This might be understood by analysing the following sentences in terms of their underlying argument (p→q, p⊢q).

(CAUSE) (EFFECT)
(1) Because he made an effort, he passed the exam.
(CONDITION) (CONSEQUENCE)
(2) If he makes an effort, he may pass the exam.
(MEANS) (PURPOSE)
(3) He should make an effort in order that he may pass the exam.
(CONCESSION) (CONTRAEXPECTATION)
(4) Although he made an effort, he did not pass the exam.

These sentences are different in the type of Logical Sequence Relation established between two members, tense and modality, but they seem to have something in common: they all imply the same underlying premise p→q, which might be expressed as a sequence of general concepts:

p q
one make an effort → one pass the exam
(Grammatical concord is intentionally breached here)

This implies that the assignment of membership meanings such as CAUSE and EFFECT to p and q and that of tense and modality are presumed to take place at other levels which follow p→q. From the decoder's point of view, the logical sequence p→q is obtained when these features are deprived of the two members of the Logical Sequence Relation.

At the present stage of my knowledge, it is not clear how many levels must be postulated in order to describe adequately the assignment of these features which distinguish each sentence. However, as long as a sentence is explained in the framework of the argument (p→q, p⊢q), we might be allowed to express it simply in the form of this argument. Sentence (1), for instance, might be expressed as follows:

p q
one make an effort → one pass the exam

p
Because he made an effort
(CAUSE)

q
he passed the exam
(EFFECT)

4. The cases in which logical sequence is in conflict with clause relational order

One of the important characteristics of the Logical Sequence Relation to be explained here is that with some change in tense, modality and aspect, the membership meanings of p and q in the sentence can be switched. This might be shown by Sentence (1a) below:

q (CAUSE) p (EFFECT)

(1a) Because he wanted to pass the exam, he made an effort.

Although the meaning of this sentence is different from (1), the underlying premise p→q obtained after removing the modality inherent in the lexical item *wanted* and the membership meanings is the same as that of (1). In (1a), however, the logical conclusion q is now realised as a CAUSE member which is explicitly signaled by the subordinator *because*. On the other hand the logical premise p is realised as an EFFECT member. This indicates that we have to distinguish between the logical order p→q and the clause relational order such as CAUSE-EFFECT.

The reversed membership meanings attached to p and q between (1) and (1a) might be better illustrated by the diagram below which explains the production of both sentences as a process of "filling the gap X" in an incomplete argument for the purpose of making it into a perfect form:

(1) p → q ... p → q
p (CAUSE) p (CAUSE)
Gap X q (EFFECT)

	p → q		p → q
(1a)	Gap X	...	p (EFFECT)
	q (CAUSE)		q (CAUSE)

In both (1) and (1a), the EFFECT member is Gap X in the incomplete argument. Whereas (1) is interpreted as the case in which the logical order p→q is in accordance with the clause relational order CAUSE-EFFECT, (1a) can be seen as the case where the logical order and the clause relational order are in conflict.

The process illustrated by the diagram might also be explained in terms of the two sentences as follows:

(1) Because p is the second premise of the argument, q is the conclusion.
(1a) Because q is wanted as the conclusion of the argument, p is the second premise.

Thus, it is possible to explain the reversed membership meanings as two different processes in which the same valid argument is completed.

5. Another underlying argument: Modus Tollen

There are other sentences of the CAUSE-EFFECT relation which are regarded as based on the same premise p→q. They are explained in relation to the argument as follows:

p → q	(a) premise	(This argument is called Modus
¬q	(b) premise	Tollen in logic)
¬p	(c) conclusion	

In this argument, the premise ¬q logically precedes the conclusion ¬p. The sentences which express the premise as a CAUSE member and the conclusion as an EFFECT member might be as follows:

¬q (CAUSE) ¬p (EFFECT)

(1b) Because he did not want to pass the exam, he did not make an effort.

This sentence is the case in which the logical order is in accordance with the clause relational order CAUSE-EFFECT. There are, on the other hand, some sentences which can be regarded as the cases where the logical order and the clause relational order are in conflict just as there are some cases similarly explained in the argument ($p \rightarrow q$, $p \vdash q$). The sentence below is one example:

¬p (CAUSE) ¬q (EFFECT)

(1c) Because he did not make an effort, he did not pass the exam.

In this sentence, the conclusion ¬p functions as the CAUSE member and the second premise ¬q functions as the EFFECT member.

6. The CONDITION-CONSEQUENCE relation

Now, let's turn to the CONDITION-CONSEQUENCE relation represented by Sentence (2) below:

(CONDITION) (CONSEQUENCE)

(2) If he makes an effort, he may pass the exam.

One might wonder if the implicit premise $p \rightarrow q$ can be interpreted in the same way as in the case of CAUSE-EFFECT relations, for *if ..., then* is usually the linguistic translation of the logical sequence $p \rightarrow q$ itself. We will see, however, some cases in which clause relational order is in conflict with logical order, and therefore, there seems to be no problem in presuming the presence of another level where the membership meanings CONDITION and CONSEQUENCE are independently assigned. We can diagramatically show the relationship between the premise $p \rightarrow q$ and Sentence (2) as follows:

p　→　q
one make an effort　one pass the exam

p
If he makes an effort,
(CONDITION)

---

q
he may pass the exam.
(CONSEQUENCE)

This diagram implies that the CONDITION member operates as the second premise and the CONSEQUENCE member as the conclusion.

This does not mean, however, that we have no candidates for the direct linguistic translation of p→q. One of them might be the following sentence which has a more general meaning than (2):

(5) If one makes an effort, one passes an exam.

This sentence has a more general meaning than (2) in that its subject is a general pronoun *one* and that the indefinite article *an* precedes the lexical item *exam*. This sentence can precede the second premise and the conclusion of the two types of arguments we have already discussed: (p→q, p⊢q) and (p →q, ¬q⊢ ¬p). Indeed, it is possible, for example, to show (5) explicitly before (1) as a sequence, although it is slightly awkward:

If one makes an effort, one passes an exam. (5)
Because he made an effort he passed the exam. (1)

It might be said that Logical Sequence Relations with their underlying premise p→q explicitly shown in such a way are "marked" form.

The logical sequence p→q is often in conflict with the clause relational order CONDITION-CONSEQUENCE: p is realised as the CONSEQUENCE member, while q the CONDITION member:

q (CONDITION) p (CONSEQUENCE)

(2a) If he wants to pass the exam, he must make an effort.

This sentence is also explained as the process in which the argument is completed as follows:

> If q is wanted as the conclusion of the argument, p must be the second premise for the argument to be valid.

Other sentences related to the Modus Tollen ($p \rightarrow q, \neg q \vdash \neg p$) are as follows:

$\neg q$ (CONDITION) $\neg p$ (CONSEQUENCE)

(2b) If he does not want to pass the exam, he may not make an effort.

$\neg p$ (CONDITION) $\neg q$ (CONSEQUENCE)

(2c) If he does not make an effort, he will not pass the exam.

(2b) is the case where the logical order is in accordance with the clause relational order, whereas in (2c) the two types of relation are in conflict. It should be added that the lexical item *want* is now necessary in (2b) where the logical sequence is in accordance with the clause relational order CONDITION-CONSEQUENCE.

7. The MEANS-PURPOSE relation

The next Logical Sequence Relation to be discussed is the MEANS-PURPOSE relation represented by (3) as shown below:

(MEANS) (PURPOSE)

(3) He should make an effort in order that he may pass the exam.

In our discussion on the CAUSE-EFFECT relation and the CONDITION-CONSEQUENCE relation, we have seen p or q realised as any of the two members of the relations explained in Modus Ponen and seen $\neg p$ or $\neg q$ realised as any of the two members of the relations explained in Modus

Tollen. When p was realised as an EFFECT member or a CONSEQUENCE member, we regarded it as the case in which the logical sequence was in conflict with the clause relational order. In such a case, we had to include the lexical item *want* in the CAUSE member or the CONDITION member. On the other hand, if ¬p was realised as an EFFECT member or a CONSEQUENCE member, we regarded it as the case in which logical order and clause relational order are in accordance. In this case we also had to include the lexical item *want* in the CAUSE member or the CONDITION member.

The reason for this review is that the MEANS-PURPOSE relation can be explained as corresponding to the CAUSE-EFFECT relation and the CONDITION-CONSEQUENCE relation which include the lexical item *want* in the CAUSE member or the CONDITION member. This might be better understood by seeing the similarity between the sentences below:

p q

(3) He should make an effort in order that he may pass the exam.
(6) He should make an effort because he wants to pass the exam.
(7) He should make an effort if he wants to pass the exam.

¬p ¬q

(3a) He should not make an effort in order that he may not pass the exam.
(8) He should not make an effort because he does not want to pass the exam.
(9) He should not make an effort if he does not want to pass the exam.

This might not be surprising because the membership meaning *purpose* includes in itself the modal meaning represented by the lexical item *want*. It should be added that q or ¬q is always realised as a PURPOSE member and accordingly, p or ¬p is always realised as a MEANS member.

8. The CONCESSION-CONTRAEXPECTATION relation

The last type of Logical Sequence Relation to be discussed in this paper is the CONCESSION-CONTRAEXPECTATION relation. Sentence (4) is an example of the relation as shown below:

(CONCESSION) (CONTRAEXPECTATION)

(4) Although he made an effort, he did not pass the exam.

This relation is explained as a contradiction which is caused by the denial of the element which is logically required for the argument to be valid. Sentence (4), for instance, is explained as a linguistic representation of the contradiction caused by the following ill-formed argument:

$p \rightarrow q$
p
(q) The element in ( ) is logically expected
$* \neg q$ *shows logical contradiction

This argument can also be presented with its elements expressed in linguistic forms as follows:

p → q
If one makes an effort, one passes an exam
p
Although he made an effort
(q)(he passed the exam)
* ¬q he did not pass the exam.

Similarly, the following three ill-formed arguments are expected to be realised as sentences:

(4a) $p \rightarrow q$ (4b) $p \rightarrow q$ (4c) $p \rightarrow q$
(p) $\neg q$ $(\neg q)$
$* \neg p$ $(\neg p)$ $* q$
q $* p$ $\neg p$

The linguistic realisation of these arguments might be shown as the following sentences:

q (CONCESSION)　　¬p (CONTRAEXPECTATION)

(4a) Although he passed the exam, he had not made an effort.

¬q (CONCESSION)　　p (CONTRAEXPECTATION)

(4b) Although he did not pass the exam, he had made an effort.

¬p (CONCESSION)　　q (CONTRAEXPECTATION)

(4c) Although he did not make an effort, he passed the exam.

(4a) and (4c) are explained as cases where the logical order p→q is in conflict with the clause relational order CONCESSION-CONTRAEXPECTATION, whereas (4b) is the case in which both types of order are in accordance.

It should be added that the logical contradiction underlying the CONCESSION-CONTRAEXPECTATION relation requires some reason for the contradiction and therefore, the CONCESSION-CONTRAEXPECTATION relation as a whole often functions as an EFFECT member and establishes a CAUSE-EFFECT relation with another clause which functions as the CAUSE member as follows:

(EFFECT)

Although he made an effort, he did not pass the exam,

(CAUSE)

because the textbook he used was too old.

9. The process in which the logical sequence p→q is established

In section 6, Sentence (5) repeated below was proposed as a candidate for the direct linguistic representation of the premise p→q underlying Sentences (1)-(4):

(5) If one makes an effort, one passes an exam.

The indefinite *one* which means *people in general* in this sentence is considered to be replaced in sentences such as (1)-(4) by some lexical items which refer to particular referents in the situation. In (1)-(4) the item *he* replaces *one*. The "present" tense and the indefinite article before *exam* in (5) are also supposed

to contribute to its general meaning, and they are also replaced by their counterparts related to the particularity of the situation.

The generality associated with the logical sequence p→q might be better understood if it becomes clear how, in the beginning, p and q are related by the logic of time sequence represented by the sign →. For this purpose, the notion of Matching Relation presented by Winter must first be referred to.

As was mentioned earlier, Winter classifies all kinds of semantic relations between two clauses into two general types. One of them is Logical Sequence Relations which we have discussed so far, and the other, Matching Relations. Whereas Logical Sequence Relations are based on the logic of time sequence, Matching Relations are independent of time order but based on the logic of comparison. Below is the definition of Matching Relations given by Winter:

> In contrast with logical sequence, the matching relation does not impose a logic of sequence upon its members other than that of the logic of comparison. In the matching relation, we are concerned with a matching or comparing of people, things, attributes, actions, states, descriptions, etc. (Winter 1982: 88)

The Matching Relation can formulaically be described as *X compares with Y with respect to Z feature.* The comparison is made either in terms of similarity or difference between what is compared. If the comparison is about similarity, the relation is called COMPARATIVE AFFIRMATION. If the comparison is about contrast/oppositeness, the relation is called COMPARATIVE DENIAL. Examples of each relation is presented below:

(10) The princes were afraid of the enemy and so were their followers. (COMPARATIVE AFFIRMATION)

(11) Whereas the princes were afraid of the enemy, their followers were not. (COMPARATIVE DENIAL)

Both sentences might formulaically be expressed as *princes compare with their followers with respect to their attitude toward the enemy.* In (10) the comparison is about similarity, while in (11) the comparison is about difference.

With the notion of the Comparative Relation explained in this way, now let's turn to the question about the Logical Sequence Relation: How are p and q related by the logic of time sequence which is represented by the sign →? A tentative answer to this question is proposed below and it suggests that the logic of time sequence is based on a kind of Matching Relation. The following text was made up in order to exemplify a situation in which p→q is established:

> Kate from the south is suffering from an eye disease. Jane from the west and Tom from the North also have the same problem. It so happens that there is a large chemical plant in all the towns where these people live.

The participants in this text are compared with respect to two similar features: the fact that they suffer from the eye disease and the fact that they live in a town with a big chemical plant. This comparison might be expressed in Winter's formulaic form with a little adjustment as follows:

> (12) Kate, Jane and Tom compare with each other affirmatively with respect to the fact that they live in a town with a big chemical plant, and with respect to the fact that they suffer from the eye disease.

If one were in a situation in which no causal relation was suspected between chemical plants and disease, one could not say more than *There must be some cause for the eye disease.* One of the possible ways in which the cause is identified might be by means of comparing people with the same disease for the purpose of identifying another common factor between them. In other words, it is by comparing the people in terms of two similar features. It is this COMPARATIVE AFFIRMATION in terms of two features between what is compared that underlies the logic of time sequence p→q.

The COMPARATIVE AFFIRMATION (12) enables us to establish a

logic of time sequence p→q, which might be expressed as follows:

> If one lives in a town where there is a large chemical plant, one suffers from an eye disease.

The generality of this sentence is explained as a result of generalising what is compared; Kate, Jane and Tom were generalised by the indefinite *one*.

One might, however, wonder if the COMPARATIVE AFFIRMATION in terms of two features is also considered to underlie a sentence such as follows:

> If Poland goes through a revolution, Russia also does.

Poland and Russia in this sentence cannot be generalised by such terms as *some country,* unlike Kate, Jane and Tom which were generalised by *one* or *somebody*. This is because Poland and Russia are not what is compared but they are two features between which the logic of time sequence is established. What is compared here is, for example, a famine, corruption and a revolution, which might be generalised by such terms as *some event*. Various events are compared about two features, that is, the two places where they occur: Poland and Russia. The formulaic presentation of this comparison might be:

> Famine, corruption and revolution affirmatively compares with each other in terms of the two places where they occur: Poland and Russia.

The logic of time sequence p → q based on such COMPARATIVE AFFIRMATION might be expressed as follows:

> If some event happens in Poland, it also happens in Russia.

Thus, we can also say about this example that the logic of time sequence p→q is established between two features which are commonly found between what is compared. It is established in such a way as to generalise all the individual events between which the comparison is made.

10. Conclusion

In this paper I have tried to explain different types of Logical Sequence Relation in the framework of arguments: ($p \rightarrow q$, $p \vdash q$) and ($p \rightarrow q$, $\neg q \vdash \neg p$). The whole description of the Logical Sequence Relation attempted here depends on the presumption of the premise $p \rightarrow q$ which has been referred to as the logic of time sequence or the logical sequence. Although the underlying logical sequence might take another form such as $p \rightarrow \neg q$ and, accordingly, the sentence realising the relation must be explained in terms of such an argument as ($p \rightarrow \neg q$, $q \vdash \neg p$), the basic procedure presented here seems to be applicable to such a case as well.

The logical sequence $p \rightarrow q$ has been distinguished from such clause relational orders as CAUSE-EFFECT because p, for example, can be realised either as a CAUSE member or as an EFFECT member. By distinguishing the two types of orders, we can explain the relationship between various sentences whose membership meanings are reversed but whose underlying logical sequence is the same. The logical sequence is presumed to be endowed with proper tense, modality, aspect, particular participants and the clause relational membership meanings in the course of linguistic realisation.

The underlying logical sequence is explained as based on a special type of COMPARATIVE AFFIRMATION; the logical sequence is established between two features which are commonly found between what is compared. This COMPARATIVE AFFIRMATION might be expressed in a formulaic way as *X and Y affirmatively compare with each other with respect to P feature and with respect to Q feature.* It is between P and Q that the logical sequence is established.

Throughout this paper, emphasis has been placed on the distinction between the clause relational order such as CAUSE-EFFECT and the logical sequence represented by $p \rightarrow q$, and the sequence $p \rightarrow q$ has been treated as if it preceded linguistic order. However, this should not be understood as implying that there is always a definite order between p and q which is universally accepted. The order is the one that is inferred from the realised sentences.

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