

SYSTEMS OF LOGIC IN TECHNICAL WRITING

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Categories of Logic in Natural Language

On the basis of earlier work in biblical translation [1], New Guinea languages [2], technical writing [3], and English language studies [4], logical connection in language has been proposed [5] as being a complex composite of three major systems:

Cause-Effect, including all connections in which one event naturally leads to another;

Purpose-Means, which explains people's aims and the means by which they seek to accomplish them (closely associated with relations dealing with problems and solutions [6]); and

Basis-Assessment (or "evaluation"), which describes all thoughtful conclusions and decisions together with the evidence, data or reasons on which they are based.

Recent detailed research in technical writing has resulted in a systematic description [7] of the methods and language signals used by skilled writers and editors to communicate these reciprocal relations of logic. These methods--principally associated nominals, verbal techniques, subordination and sentence adjuncts--are outlined in this paper.

Associated Nominals (Syntagmes Nominal [SN] Associés)

As extensions of earlier work into the semantics of the English articles in context [8] and later developments [9, 10, 11, 12], analysis is now available dealing with the connection between noun phrases (or simply "nominals") associated with earlier lexical inputs in the text. Of particular interest to us here are associated nominals which indicate one of the three logical relations (e.g., The effect of this catastrophe, The purpose of this). These associations can be very simple (e.g., The results) or quite complex:

- (1) Les conclusions générales que l'on peut tirer de cet exemple sont de deux ordres. Les premières . . . Les secondes . . . (GEOS, Automne 80, p. 11)

The writer has "re-entered" a large part of the previous text as cet exemple within the larger associated nominal Les conclusions . . . exemple as subject of the sentence. The larger nominal group is "associated" with the part being re-entered, and the logical relationship, of assessment, is signalled by conclusions. A simple associated nominal follows:

- (2) The size and density of the planet adjust themselves so that the outward pressure of the compressed material exactly balances the inward pull of gravity at any given place in the planet's interior. The result is a state of hydrostatic equilibrium. (Scientific American, Dec. 81, p. 90)

Rather than The result of this adjustment, simply The result is used here with the connection between the associated nominal and the previous sentence being implicit. This is an "untriggered" association, whereas the subject of Example 1 is a "triggered" associated nominal. The main relation of Example 2 is, of course, one of cause-effect, but there is a further joint effect/purpose relation signalled by so that in the first sentence.

Complex associated nominals occur in which a logical relation is compressed within a nominal group--a concept known as "rank-shifting". Thus instead of "The result was a chemical reaction which . . .", this information is conveyed within the nominal group "The resulting chemical reaction". Here is an example:

- (3) Jusqu'à maintenant, deux variétés de charbons de l'Est du Canada et deux de L'Ouest ont été traitées magnétiquement. Les résultats obtenus sont assez intéressants pour justifier la poursuite des travaux dans ce domaine. (Geos, Automne 81, p. 17)

Les résultats ont été obtenus du travail indiqué dans la première phrase, mais l'auteur a décidé de ne pas écrire "On a obtenu les résultats de ce travail, et ces résultats sont assez . . .", puisque le texte utilisé lui permet d'obtenir une rédaction plus claire et concise. Le rapport dans le syntagme nominal en est un de cause à effet, et est relié à la phrase principale dans un rapport de base-conclusion, indiqué par le verbe infinitif justifier.

Example 3 is an instance of partial triggering, in which obtenus provides some reference to earlier parts of the text but does not provide the full reference such as obtenus de ce travail.

Méthodes Verbales (Verbal Methods)

Les verbes principaux sont utilisés fréquemment pour indiquer tous les rapports logiques. Voici un exemple qui contient le verbe principal est attestée pour communiquer le rapport de base-conclusion:

- (4) L'existence de ce courant est attestée par des flèches littorales émergées. (GEOS, Automne 82, p. 7)

Dans cet exemple, la base pour le conclusion de l'existence du courant mentionné auparavant dans le texte est l'existence des flèches, est ce rapport est indiqué par le verbe principal de la phrase.

Le rapport de cause-effet est illustré par l'exemple suivant, qui contient le verbe principal élimine pour indiquer le rapport.

- (5) La sélectivité de la séparation a été assurée par l'acide sulfurique et non fluorique comme dans le procédé classique. Cette nouvelle approche élimine un réactif couteux, nocif et dangereux. (GEOS, Automne 82, p. 19)

La première phrase de cet exemple est relié par le SN Cette nouvelle approche, ce qui donne aussi le renseignement que [l'approche est nouvelle]. Par ce moyen, la première phrase devient une partie du rapport cause-effet, indiqué par le verbe principal élimine.

Rather than using Ce, This or other substitute forms to re-enter the first part of a relation into a new sentence, and a main verb (e.g., results) to signal the relation, a non-finite verb form (e.g., resulting) is used if sentence length permits. Other verbs not so clearly indicating logic are often supplemented by thereby or thus in English to strengthen the signalling of the logical relation:

- (6) Near the geomagnetic equator both types of bacteria are found and both are directed horizontally, thereby reducing potentially harmful upward excursions. (Scientific American, Dec. 81, p. 65)

The brevity of both clauses allows the non-finite form of the verb to be used instead of This reduces in a separate sentence, and thereby reinforces the logical relation.

Quoique la plupart des rapports logiques sont indiqués par les verbes principaux, on peut trouver des verbes subordonnés utilisés dans le même but. L'exemple suivant contient la forme du verbe Etant donné qui domine la phrase enchâssée initiale pour présenter le rapport de base-conclusion:

- (7) Etant donné la simplicité du procédé et les avantages considérables des produits perlés, il est étonnant de ne pas trouver plus de matériaux perlés sur le marché. (Revue de l'Ingénieur, Jan. 84, p. 21)

La base pour l'étonnement qu'on ne trouve pas plus de matériaux perlés sur le marché est donnée dans la phrase enchâssée, et est indiquée par le verbe Etant donné. En anglais, le mot Given est utilisé souvent pour indiquer le même rapport [6].

Les Phrases Enchâssées (Subordination)

Les phrases enchâssées, avant ou après la phrase principale, sont utilisées pour indiquer tous les rapports de logique. Deux raisons (bases) ont données pour le conclusion dans l'exemple suivant:

- (8) En raison des pressions qu'impose le monde actuel du travail et vraisemblablement à cause du sens critique qu'il faut développer l'intérieur de cette profession, plusieurs ingénieurs ont tendance à envisager avec beaucoup de scepticisme tout engagement de type social. (Revue de l'Ingénieur, Fev. 82, p. 2)

Les bases sont indiquées par En raison de et à cause de dans les phrases enchâssées, et le conclusion des ingénieurs suit dans la phrase principale. Notez que les mots des et du ici contiennent des éléments des signaux de base et aussi le sens des articles des noms suivants.

Subordination before the main clause is used when the subordinate clause contains information known to the reader (often even included earlier in the text) [13]. Here is an example:

- (9) Your job is very important to you. The security and self-satisfaction it gives you and your family have more value than can be measured in dollars and cents. Because your job means a great deal to you, you should be concerned about the seldom-suspected means that are used to drain businesses of propriety information. (Standards Engineering, Apr. 75, p. 389)

The first sentence is re-entered as the subordinate synonym clause in the third sentence. Subordination is used to prevent the known information being given the status of independent clause, which is used to indicate newly introduced information. Many of the criteria for using pre- and post-subordination have been analyzed [7], and the semantic connection between both types of subordination and the independent clause has been discussed in some depth [13].

Sentence Adjuncts (Procédés d'Adjonction de Phrases)

Although subordination and connection by sentence adjuncts such as therefore and consequently have separate grammatical and semantic functions, there is an interesting connection between them. Rather than using a full subordinate clause dominated by Because, the writer can, under certain circumstances, use Because of this or As a result of this, which act as logic-signalling sentence adjuncts and also provide overt connection (by the substitute this) with the first part of the binary logical relation. We can then imagine of this being deleted from As a result of this to arrive at the true sentence adjunct As a result, which shares the roles of Therefore, Accordingly and Consequently. This approach allows us to understand the connecting role of such words:

- (10) The death or disability of a key employee or owner can seriously affect credit, production, and profit. Accordingly most bankers want life insurance as additional collateral on business loans. (Engineering Digest, Sep. 83, p. 29)

Une autre méthode d'écrire cet exemple est d'utiliser Because of this ou As a result of this pour indiquer le rapport de base-conclusion entre les deux phrases. Il est important de reconnaître que Therefore, Consequently, En conséquence et d'autres mots de ce genre indiquent les rapports logiques entre deux parties définies du texte. Un exemple complexe suit:

- (11) Les formes de ces regroupements et leur corrélation laissent fortement croire qu'ils sont la traduction, en surface, des cellules individuelles de convection à l'intérieur d'un plus grand batholithe, tronquées à quelque niveau médian par l'érosion. En conséquence, la foliation primaire et les linéaments d'écoulement des minéraux doivent être contrôlés par la géométrie du flux de convection à l'intérieur de ces cellules, de manière similaire à l'alignement des minéraux à l'intérieur des dômes de sel. (GEOS, Automne 80, p. 11)

The main relation is one of cause-effect between the two sentences, and this is signalled by En conséquence. Within the second sentence there is a further relation (of effect-cause) indicated by doivent être contrôlés and in the third sentence a means relation signalled by manière.

This is but a small glimpse of the complexity of logical connection and signalling in actual language use.

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