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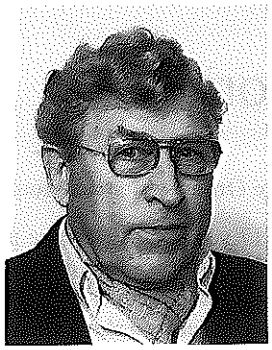

# Methods of Subject-Structure Display

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The aim of this paper is to investigate various methods of displaying the organization of a collection of interrelated subjects with an indication of types of relationships between the subjects involved. As an introduction, hierarchical and associative subject-arrangements are demonstrated. Then follows an exposition of the general basis of subject-relationships which leads to a demonstration, by examples, of various forms of display.

(Author)

## 1. Introduction

By a subject-structure we shall understand a collection of subjects interrelated in various ways. Linguistically, the structure can be designated either by one term (in which case the structure is expressed by the corresponding definition), or by a more or less complicated linguistic expression. To display the structure, several methods are available.

The key terms in this connection are 'subject', 'concept', and 'class' (see (1)). Here it is a well-known fact that, disengaging our attention from individual differences in subjects considered, human minds are able to form concepts which are of an abstract nature, and on the basis of which we can sort out subjects in our surroundings and in our minds as belonging to various classes, each corresponding to a certain concept. Thus we avoid having to consider each of these subjects as being unique, so that order is brought about in our perception of subjects in a world which would otherwise appear chaotic.

This process of abstraction can, however, be graduated. If we abstract from a greater number of differences, the corresponding concept will become broader and vice versa.

A concept and a corresponding subject, thus, is a matter for the perceiving I, but normally we talk of 'subjects', not of 'concepts of subjects', 'concept' being implicit.

The recognition of a subject is aided by the use of the linguistic expression corresponding to the class (and hence to the concept) to which it belongs, but then a discrepancy arises, one which plays a fundamental role in this field: linguistic expression versus its content, where 'content' is the subject(s) denoted by the expression used.

## 2. Arrangement of Subjects

The hierarchical forms of subject-arrangements have their basis in a subject, B, which is a component of another subject, A, which in its turn is a component of a third subject; in addition B can have a fourth subject as a component etc.

To denote the relationship between A and B we write:

A has B as a component
B is a component of A,

or, if we prefer a shorter notation A ⟩ B, B ⟨ A,
which we could call a 'has-relationship' and an 'is-relationship' respectively.
Examples:

- If A is a class determined by the corresponding concept, any subordinate class will be a component of A.
- If A is a material subject, then any physical part of it will be a component of it.

The two examples are, of course, concerned with the generic and the partitive type of relationship, respectively.

When three subjects are involved, we can think of arrangements such as

A ⟩ B ⟩ C ... and A ⟨ B ⟨ C...

where the connectors[1] are alike, but also

A ⟩ B ⟨ C... and A ⟨ B ⟩ C ...,

where they alternate.
The first type is found in generic and partitive hierarchies, for instance

The class of carnivores ⟩ the class of lions ⟩ a specimen of the class of lions
The furniture of a TV room ⟩ the TV-set ⟩ the cathode-ray-tube.

An example of arrangements with alternating connectors we have in

symbols ⟩ numbers ⟨ number theory
paper ⟨ paper-manufacturing ⟩ relevant raw materials.

Now, a hierarchical arrangement can contain several subjects but will yet, due to the course of nature, be of limited extension.

In contrast to the arrangements where the connectors are alike throughout we can think of a 'horizontal' arrangement where the connectors alternate. Such arrangements will be found in a 'free' chain of associations, i.e. where no specific theme is involved.

A general feature here is that in the mind a given subject is grouped with another one which in its turn is grouped with a third one and so on. As this process is dependent on the person's own spiritual inventory' it is consequently of a personal nature[2].

As an example here is an experience of the author's, in narrative form:

Sitting in a chair caused him to direct his attention towards a poem 'When I sit in my chair' by the Danish poet Holger Drachmann who spent the latter part of his life in the town of Skagen (on the northern tip of Jutland). Fine beaches are found here which, however, are also found at the hamlet of Henne much to the south. In the local church at Henne is an interesting altar-piece. ...

Now in the formal pattern:

Sitting in a chair ⟩ the chair ⟨ the poem: 'When I sit in my chair' ⟩ the poem ⟨ the poem being written by H.Drachmann ⟩ H.Drachmann ⟨ H.Drachmann living in Skagen ⟩ Skagen ⟨ the beaches of Skagen ⟩ beaches ⟨ the beaches of Henne ⟩ Henne ⟨ Henne church ⟩ the altar-piece of Henne church ⟨ the altar-piece ...

The succession took less than a few seconds to go through and it was interrupted by a phone-call.

Attention should be drawn to what was said above: '... in the mind a given subject is grouped with another one which in its turn is grouped with a third one ...'. Looking further into the matter, another point of view will turn up: Among all the subject connections in which a certain subject is a component and which are present in the person's mind, only one is chosen, the one which is uppermost in that mind, this choice representing the personal influence.

This means, however, that the linguistic expression of a given subject (chair, poem, H.Drachmann etc.) is a label for all these subject connections in the same manner as the title of a book is (or ought to be) a designation of the contents of the book, which deals only with the corresponding subject in all the connections in which it is found.

If we adopt this view all the connectors will have to be changed to their opposites.

It is clear that in theory the chain of associations could have gone in the opposite direction, but here it should be stressed that such a chain will supposedly always start with some stimulus from outside. (cf: 'sitting in a chair'). This phenomenon is more commonly known from social gatherings where the conversation, because of some outside influence (the arrival of another guest, the start of a thunderstorm, the message of 'dinner is served' etc.), can suddenly take a new turn. Another observation is that the number of participants in a conversing group is normally two, three or four.

The contrast to the above-named cases can be seen in a person's mental activity concerning one subject, or where several persons participate in a discussion; here the associations cannot go very far from the subject discussed, if the chairman does his job properly.

## 3. Specification of Relationships

Up to now we have considered hierarchical and 'horizontal' subject-arrangements from a general view. There are, however, a variety of other types of relationships.

In the world we live in, changes play a fundamental role. A static universe in which everything, mental activity included, would have stopped, would be in contrast.

By 'change' we shall understand that a relationship between two subjects disappears (for instance: N.N.forgot the phone-number, the text was erased from the paper) or appears (for instance: The inventor got an idea, the lid was placed on the jar). In such cases we talk of a 'dynamic connection'.

If we denote the subjects by A and B, the initial and terminal situations of the two types of dynamic connections just described can be expressed respectively as:

A in relation to B
A without relation to B,

if the connection between A and B disappears, and:

A without relation to B
A in relation to B,

if it appears.

In order to characterize the type of relationship by which A and B are linked, we introduce the concept of 'indicator' which is a subject generically subordinate to B; then 'A in relation to B' can be expressed as:

A has B as its indicator
B is the indicator of A

Example:

The drawing has the paper as its substrate
The paper is the substrate of the drawing.

The expression denotes a static connection in which A is called the *main subject* and B the *related subject*.

The two above-mentioned types of dynamic connections, where a static connection disappears and appears, respectively, are the basis of the third type which is a combination of the two, viz:

A has B as its indicator
A has C as its indicator,

where the relationship between A and B disappears and that between A and C is substituted while the indicator is unchanged. This means that we are concerned with the same type of relationship.

In the case of a dynamic connection the main subject (s) in the two static connections is called the *object*, the related *s* in the first one the *pre-related s* and the related *s* in the latter the *post-related s*.

Example:

'The dress was cleaned':
The dress has 'dirty' as its property
the dress has 'clean' as its property, or

'The dress was cleaned'
has *dress* as its object
has *'dirty'* as its pre-related s
has *clean'* as its post-related s
has *property* as its indicator.

However, if each of the two static connections can be expressed in one term we talk of *pre-object* and *post-object*. This is the case when a subject is changed to 'something different', viz. if the indicator is 'concept' (e.g., 'form').

Example:

'The cloth was reduced to shreds'
The material has 'cloth' as its concept
the material has 'shreds' as its concept, or

'The cloth was reduced to shreds'
has *cloth* as its pre-subject
has *shreds* as its post-subject

which implies that the object is the lowest superordinate term (here 'material') which contains both 'cloth' and 'shreds' and that the indicator is 'concept'.
After having identified the above components of a *dynamic connection (dcn)*, components which form its 'nucleus' we might ask for the cause of the change, which is the *agent*.

But as the agent acts at a certain point of time one could ask: 'Why just at that point of time?' The answer must be that there is another subject involved which stimulates the agent and provokes the change. Thus the real cause of the change is the forming of a static connection between the agent and its instigator, which implies that this static connection is a post-relationship of a previous dynamic connection.

Now the agent often uses an *instrument* to carry out the change of the relationship of the object. The use of an instrument is primarily conditioned by its type, which is limited by the *governing subject*. As the choice is further conditioned by an intelligence, it is seen that only an animate agent can use an instrument[3].

Apart from these subjects we shall have to take into account the *location in space* of the *dcn*: Absolutely, or in relation to one or several material subjects. Further its *location in time*, its date, or in relation to some event (before, after, at the same time), or in relation to this moment (past, future, present).

With respect to the pre- and post-(related) subjects, they can be indeterminate, in which case the type of the *dcn* is shown by the indicator alone.
Examples:

'John is walking'
has *John* as its object
has *'location'* as its indicator
has *John* as its agent
has *'present'* as its location in time

'The material has been changed'
has the *material* as its object
has *'property'* (or 'concept') as its indicator
has *'past'* as its location in time

## 4. The Indicators

In the two synonymous formulas

A has B as its indicator
B is the indicator of A,

A is, as stated above, the main subject, and B the related subject. The formula shows that B is a subject belonging to a group of subjects determined by the indicator where A determines the subject in question.
Example:

The drawing has the paper as its substrate
The paper is the substrate of the drawing

If we exchange A and B in the above formulas the indicator will change to a 'reciprocal' counterpart. This means that the four formulas are equivalent:

A has B as its indicator (1)
B is the indicator(1) of A
B has A as its indicator(2)
A is the indicator(2) of B

The second pair of these formulas applied to the above example gives:

The paper has the drawing as its 'substrated *s*'
The drawing is the 'substrated *s*' of the paper.

We are, however, forced to take into account the case where the main subject is identical with the group of subjects determined by the indicator. In this case we have:

A has B as a component
B is a component of A,

i.e., A is the group of subjects to which B belongs.

But if we want to express the relationship between A and B with B as the main *s* and A as the related *s* we arrive at the awkward expressions (see (5), Sect.6.1):

B has A as its 'containing *s*'
A is the 'containing *s*' of B.

Examples:

61 has the prime numbers as its 'containing *s*'
The prime numbers are the 'containing *s*' of 61

which should be expressed by a reciprocal indicator:

The prime numbers have 61 as an item
61 is an item of the prime numbers.

This situation occurs, as stated, when we have a relationship between a subject, B, and the group of subjects, A, to which it belongs.

In the four cases which are illustrated by the following examples we shall have to express the relationship with A as its main *s*.

The union has N.N. as a member
N.N. is a member of the union.

The book has the title-page as a part
The title-page is a part of the book.

The material subject has its weight as a property
The weight is a property of the material subject.[4]

Literary activity has the author as its agent
The author is the agent of literary activity[5].

## 5. A Two-Dimensional Display of Subject-Relationships

When we are concerned with a greater number of more or less interrelated subjects it is possible to show the mutual relationships by giving a consecutive (linear, one-dimensional) enumeration of the static and dynamic connections in which the subjects appear.

This will not, however, give a satisfactory survey and therefore we want to establish a two-dimensional display.

Let us take again the two formulas as our basis:

A has B as its indicator(1)
B is the indicator(1) of A.

Instead of using the 'has- and is-formulas' we can show the relationship of the subjects simply by their positions in relation to each other. Thus:

A i(1) B

reading from left to the right, expresses the first of the above formulas (A has B as its indicator(1) but, reading from the right to the left, the latter one (B is the indicator(1) of A). Consequently:

B i(2) A

expresses both

B has A as its indicator(2) and
A is the indicator(2) of B

when reading from left to right and vice versa, respectively.

Now let us look at a succession of formulas, i.e. a one-dimensional display of interrelated subjects, say

A has B as its indicator(1)
C has B as its indicator(2)
B is the indicator(3) of D
D is the indicator(4) of E
E has F as its indicator(5)
F has G as its indicator(6)
G has H as its indicator(7)
G is the indicator(8) of J.

The corresponding two-dimensional display, then, is

A i(1) B
C i(2) B
E i(4) D i(3) B
E i(5) F i(6) G i (7) H
J i(8) G

When we consider individual cases it can be convenient to use symbols of repetition: /, //, ///, ..., for instance:

A i(1) B
C i(2) /

It should be noted that, unless they are identical, two subjects placed over and under each other are not directly related, but related 'through' a third subject.

Example:

A i(1) B
C i(2) /

i.e., A has B as its indicator(1)
B is the indicator(2) of C,

where A is related to C 'through' B.

If, in a succession of connections, some unwanted indicators should occur, we would have to 'twist' the corresponding relationships.

Examples:

If in the succession

A i(1) B i(2) C i(3) D

the indicators i(2) and i(3) are unwanted we get:

A i(1) B
C i(4) /
D i(5) /

where i(4) and i(5) are reciprocal indicators of i(2) and i(3), respectively.

It appears that the more indicators of this type, the more tendency there is of stretching the subject-structure vertically. Likewise, it will increase the number of repetition symbols.

Moreover, it should be remembered that a structure can branch off, that is: Certain subjects can be placed as nodes.

Example:

A i(1) B i(2) C i(3) D i)(4) E
/ i (5) F i(6) G i(7) H
/ i(8) J,

where B and G are nodes.

## 6. Application of the Method

The linguistic expression of a subject is a condition of conveying a concept from one human being to another. Hence linguistic considerations play an important role in this respect.

Consider a subject the linguistic expression of which is simple, e.g. consisting of one word, or term. Then it is clear that the linguistic expressions of the subjects contained in its structure, and thus defining it, are implicit because otherwise we should not know what the single term designates. Thus the definition of the subject in such a case is the key to the structure.

But even if the definition of the subject is a complicated linguistic expression a number of subjects will normally be implicit. Thus the first step of the procedure is to note the linguistsic expressions of these subjects.

Below, we shall give two examples of the subject structures of various types of expressions: A subject expressed either in one term or in a complicated linguistic expression.

### 6.1 A subject expressed in one term. Example

'A philatelist is a person who is interested in stamps and (consequently) collects stamps'.

Here we have the following relationships:

A philatelist
  has a *person* as his superordinate concept
the person
  has an *interest* as his property
the interest
  has *stamps* as its concern
  is the agent of *stamp-collection*[6]
stamp-collecting
  has *stamp-collection* as its post-*s*
stamp-collection
  has *stamps* as its items.

This one-dimensional display corresponds to the two-dimensional one shown in Fig. 1.

As the interest is related to three (i.e. more than two) subjects the structure branches off at this subject which then is a nodal point.

The example can, as stated above, be seen as a case where the terms contained in the structure are implicit. They are 'condensed' into the one term of 'philatelist'.

### 6.2 A subject expressed as a complicated linguistic expression. Example

Here we take an example given by J. Perreault in (8):
'French case-book on the use of glass vacuum chambers in the prevention of the rapid decay of radioactive isotopes used in the measurement of turbulent flow in pipes'.

To begin with, this subject can be split up into the connections below:

- French case-book on the use of ...
- the use of glass vacuum chambers in the prevention of rapid decay ...
- rapid decay of radioactive isotopes ...
- radioactive isotopes used in the measurement of ...
- the measurement of turbulent flow.

In the next step, we call forward the implicit expressions of subjects entering the structure together with eventual preferred reformulations.

As for 'the prevention of the rapid decay of radioactive isotopes' we prefer to formulate it in 'positive terms' as 'prompting a slow decay of radioactive isotopes'.

| philate-list | 'superor-dinate concept' | person | 'property' | interest | | |
|---|---|---|---|---|---|---|
| | | stamp-collecting | 'agent' | //////// | 'concern' | stamps |
| | | ///// | 'post-s' | stamp-collec-tion | 'items' | ////// |

Fig.1

After these considerations we arrive at the following one-dimensional display:

Case-book
has the *text* as its 'substrated *s'*
has *France* as its place of origin[7]
the text
has *'the use of ... in prompting ...'* as its content
the use of ... in prompting ...
has *radioactive isotopes* as its pre-*s*
has *decay products* as its post-*s*
has *'slow'* as its property
has *glass vacuum chambers* as its instruments
radioactive isotopes
are the instruments of *'finding the measure...'*
finding the measure ...
has the *measure* as its post-*s*
the measure
is a property of the *turbulence*
the turbulence
is a property of the *flow*
the flow
has *liquids* as its object
has *k 'location'* as its indicator (see sect.3)
has *pipes* as its location.

The corresponding two-dimensional display is shown in Fig.2.

## 7. Considerations on the Instrument

As an instrument we shall here understand a material, inanimate subject used by an animate agent to bring about a change of a relationship of the object[8].

The instrument, however, is without importance unless it is used, and hence we shall consider

'the use of an instrument to bring about a change in the relationships of the object'.

But this dynamic connection is preceded by 'choice of an instrument' which is clearly an intellectual process found only in connection with animate agents; since an animate agent cannot act without using its voice, its hands etc., the parts of the body should be considered as possible instruments permanently attached to it[9].

Now a change of a relationship in the cases which we shall consider here is equivalent to the accomplishment of a post-connection between the object and a post-related s and thus the following components of the *dcn* claim special attention:

– the instrument
– the object
– the post-related *s*.

Regarding the indicator it will - as a rule - be a 'located *s'*[10].

Often, we have a succession of *dcn*s with the same agent adopting several instruments in their turn, in which case we observe that three distinct subjects in the above functions have their functions 'displaced' in the following *dcn*.

| flow | 'object' | liquids | | |
|---|---|---|---|---|
| //// | 'indica-tor' | location | | |
| //// | 'location' | pipes | | |
| //// | 'property' | turbulence | 'property' | measure |
| | | finding the measure ... | 'post-s' | /////// |
| | | /////// | 'instru-ment' | radio-active isotopes |

| case-book | 'substra-ted s' | text | 'content' | the use of ... in the prompting ... | 'pre-s' | ///// |
|---|---|---|---|---|---|---|
| ////-//// | 'place of origin' | France | | /// /// // | 'post-s' | decay products |
| | | | | /// /// // | 'property' | slow |
| | | | | /// /// // | 'instru-ment' | glass vacuum chambers |

Fig. 2

As an illustration let us consider a *dcn* such as 'the painting of a wall', which dissolves itself into the following *dcn*s:

The painter
– extending his hand and taking the brush
– moving the brush into the paint
– transferring the paint to the wall
– giving the wall an(other) colour.

Enumerating the components of the said *dcn*s we get:

extending the hand and taking the brush
has the *painter* as its agent
has the *painter's muscles'* as its instrument
has the *painter's hand* as its object
has the *brush* as its post-related *s*
has *'located s'* as its indicator
moving the brush into the paint
has the *painter* as its agent
has the *painter's hand* as its instrument
has the *brush* as its object
has the *paint* as its post-related *s*
has *'located s'* as its indicator
transferring the paint to the wall
has the *painter* as its agent
has the *brush* as its instrument
has the *paint* as its object
has the *wall* as its post-related *s*
has *'locating s'* as its indicator
giving the wall an(other) colour
has the *painter* as its agent
has the *paint* as its instrument
has the *wall* as its object
has the *colour* as its post-related *s*
has *property'* as its indicator.

The interplay of the said three subjects is clearly presented in Fig.3.

If we consider the *dcn*

'the use of an instrument'

without regarding what its use will bring about, it is found that it functions here as an object and as such is ex-

| | extending ... | moving ... | transfer-ring ... | giving ... |
|---|---|---|---|---|
| the painter | 'agent' | 'agent' | 'agent' | 'agent' |
| the painter's musoles | 'instru-ment' | 'instru-ment' | 'instru-ment' | 'instru-ment' |
| the painter's hand | 'objeot' | 'instru-ment' | 'instru-ment' | 'instru-ment' |
| the brush | 'post-related s' | 'object' | 'instru-ment' | 'instru-ment' |
| the paint | | 'post-related s' | 'objeot' | 'instru-ment' |
| the wall | | | 'post-related s' | 'objeot' |
| the oolour | | | | 'post related s' |
| indicator | 'located s' | 'located s' | 'locating s' | 'property' |

Fig. 3

posed to some change which normally is negligible, since it will consist in a change of location relative to the agent, and eventually also in a change of property.
Examples:

The use of a saw.
The use of a telescope.

In the first case the saw - after the wood-cutter has taken it (change of location) - is exposed to a continuous change of location as well as to slight wear.

In the second case, a small telescope, after having been taken by the user (change of location), is exposed to no change of its properties. If, however, we are concerned with an astronomical telescope with permanent location the change of location is on the part of the astronomer.

## 8. Conclusion

Looking back at the two-dimensional display which closes section 6 the question arises as to whether this type of display can be used in a satisfactory way in all cases of subject structures. Regrettably the answer is 'no', which a glance at the display in section 7 will make evident. Here it is seen that the *dcns* in question (extending ..., moving ...) are related to each other by two subjects. For instance 'moving ...' and 'transferring ...' have the common subjects of 'painter' (agent) and 'brush' which functions as the object in 'moving ...' and as the instrument in 'transferring ...'.

The consequence is that in the two-dimensional display a certain subject will appear twice in the structure in two disconnected places, which must be considered a drawback.

Hence is seems that in order to display the relationships of every subject at the same time we must adopt quite another type of display. This is an alphabetical enumeration of the subjects in question with their related subjects.

Applying this method to the example we get (as extract):

The brush
  is the object of *'moving ...'*
  is the post-related *s* of *'extending ...'*
  is the instrument of *'transferring ...'*
the colour
  is the post-related *s* of *'giving ...'*
extending ...
  has the *painter's hand* as its object
  has the *brush* as its post-related *s*
  has *'located s'* as its indicator
  has the *painter* as its agent
  has the *painter's muscles'* as its instruments
the painter
  is the agent of *'extending...'*
  is the agent of *'moving...'*
  is the agent of *'transferring...'*
  is the agent of *'giving ...'*

This type of display has a superficial likeness to a thesaurus, but no more than superficial. It should be considered a means of presenting a display of a subject structure with emphasis on the single subject, a display which, however, gives a poor view of the structure.

In comparing the two-dimensional display with the one above, we observe an example of a complementarity which is commonly found in a variety of fields. If we want to demonstrate the structure we cannot always show directly the relationships of the single subjects, and if we want to attach importance to them the structure is obscured. In a certain sense this is a demonstration of the incompatibility between the collective and the individual.

## Notes

1 By 'connector' we understand a symbol which indicates that a subject A has another subject B as a component and vice versa.
2 Attention should be drawn to the book by J. Deese (in (2)) in which he has treated the subject.
3 Cf. Johansen (4), Sect. 2.3 with reference to Fillmore.
4 A material subject is considered here as 'consisting' of its properties.
5 Here the literary activity is a dynamic connection which consists of its components (agent, instrument etc.)
6 The process is instigated by the coming into existence of the interest in the person, and as long as it is found there the process will continue.
7 Or 'the text has French as its language'. This interpretation, however, is impossible to show in the two-dimensional display in Fig. 2 since there is 'no room for it'. The 'twisting' of the relationship, moreover, is also impossible because we have no reciprocal indicator corresponding to 'language' (which is in fact a property: French has the text as its ?).
8 The definition is derived from that of Longacre, p. 31. Cf. Fillmore's considerations on the instrument, p. 22-23.
9 Cf. Johansen (5), Sect. 4. Longacre makes the question dependent on the type of action.
10 The fact that certain indicators should not be used (see sect. 4) is not without significance in this respect (cf. note 7).

References see p. 44