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Directionality in Discourse: Prominence Differences in Subordination Relations[1]

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Abstract

This paper proposes a new approach to *discourse directionality*, a phenomenon which, as is well known, is neither well defined nor adequately accounted for. Directionality is the property of (a part of) a discourse to be directed towards a 'goal', usually implying asymmetric functional relations between the discourse units involved. The direction of such an asymmetric discourse relation depends on whether the unit that provides the goal-satisfying value precedes or follows the unit which is subservient to it. Fundamental to our proposal is an analysis of directionality in terms of the *topic-comment distinction*. Within this framework, directionality is defined as a recursive property assigned to higher-order and lower-order discourse relations central to which is the assumption that they are realized by explicit or implicit topic-forming questions. It will be shown that the distinction that can be made between three types of directionality is precisely a function of three different ways of quantitative/qualitative subordination realized by subquestioning. Apart from the resulting theory providing a solution to the *definition problem*, it also provides an answer to the *determination problem* which implies that we attribute a criterion to distinguish dominant discourse units from subservient ones. In addition, the theory contributes to the much discussed issue of an adequate formalization of those discourse elaboration processes that do not involve a new partial value but merely *support* an already introduced 'subject matter'.

1 INTRODUCTION

If one is confronted with the task of structuring an extended answer to a question, there are, in principle, three options: first, operating towards the 'goal' of the question implying the so-called goal-subservient part to precede the part providing the goal-satisfying value; second, acting inversely, by firstly specifying that which is ultimately asked for and then elaborating on it for supportive reasons, e.g. providing a justification of the answer value given; and third, acting as it were in both directions, implying that the discourse units comprising the extended answer are mutually subservient in satisfying the goal of the question.[2] However, it is generally assumed (especially Allen 1983; Allen & Perrault 1980; Grosz & Sidner 1986; Litman 1985; Mann & Thompson 1988; Moore & Pollack 1992; Pollack 1986; Wilensky 1983) that these options apply not only to the structure of complex answers to explicit questions but also to the structure of extended discourse in general.

The phenomenon under discussion is that of *discourse directionality*, a phenomenon that is central in, in particular, the rhetorical and intentional approaches of discourse structure.[3] Directionality refers to the property of (a part of) a text to be directed towards a 'goal' or 'point', usually resulting in asymmetric functional relations between discourse segments. This asymmetry implies a division of (that part of) the text into two related segments, one of which is subservient to the other, with the latter being identical to the part providing the goal-satisfying value or a part of this value.

Various terms are used to refer to the phenomenon of directionality. A frequently used term is *nuclearity* in Rhetorical Structure Theory (RST; e.g. Mann & Thompson 1988). In RST, nuclearity is considered to be 'a central organizing principle of text structure' (1988: 267), referring to a functional distinction applicable to rhetorical relations between discourse units ('spans'), namely that one of them, the *nucleus*, is functionally dominant while the other related unit, the *satellite*, is subservient. It is assumed that in most cases a functional asymmetry such as this is present in, e.g., 'If A is evidence for B, then B is not evidence for A' (1988: 266).

Another term commonly used in the intentional approaches of discourse structure is the term *dominance* (Grosz & Sidner 1986). The term refers to one of the characteristics of intentional relations between discourse segments, namely that if one discourse segment purpose DSP_1 *dominates* another discourse segment purpose DSP_2, DSP_2 *contributes* to DSP_1 (1986: 179). As made clear in Moser & Moore (1993), dominance relations such as these correspond to the direction of intentional relations in RST, i.e. 'the satellite span, S, affects the purpose of the nucleus span, N, only if the intention that S realizes is dominated by the intention that S and N (and possibly others) realize together' (1993: 95).[4]

However, in spite of the central role of directionality in theories of discourse structure, we are nevertheless confronted with both a *definition* and a *determination problem*. The former is probably the most serious one and implies the absence of a fully adequate formal definition. For instance, RST, in which the notion of directionality is most central, does not provide so much a definition as a taxonomy of characteristic properties of this notion. The characterizations given are, among others, that the dominant discourse unit, the nucleus, is 'more essential to the writer's purpose', is 'more central', is 'more deserving of response, including attention, deliberation and reaction'. Although many of these characterizations present relevant descriptions of the phenomenon, they do not show the kind of phenomenon with which we are precisely dealing. In particular, they lack a full explanation of why the non-dominant part, the satellite, may be deleted while preserving the coherence and intention of the text. In addition, they

leave unexplained why the dominant part is functionally more prominent, i.e. more deserving of attention, deliberation, and reaction than the functionally less prominent part. Obviously, if a definition is to be considered adequate, it must provide satisfactory answers to these questions.[5]

Closely related to the definition problem is the task of determining the relevant factor stating which of two related discourse units is functionally dominant. It is generally assumed that in the case of functional asymmetric discourse relations the order of dominant and non-dominant discourse units is not directly influenced by the discourse relation between them. The literature also fails to provide an adequate solution to this problem.

In addition to the definition problem and the determination problem, one more issue, though a less central one, has to be mentioned, namely the *formalization of non-dominant, supportive discourse units.* Usually a considerable part of discourse consists of justifications, motivations, etc. which in themselves do not introduce a 'subject matter' or 'independent value', but have a supportive function with respect to the dominant discourse parts which provide such a value. How can the effect of this supportive material be formalized in terms of, e.g., set theory, if the function of this material is merely a secondary, not providing independent values as such?

We will propose an account of directionality which provides an adequate definition of the phenomenon including a corresponding criterion for identifying functionally dominant and non-dominant discourse units. In addition, the proposal provides the formalization referred to above. Essential to the proposal is an account of directionality in terms of the topic-comment distinction which, by definition, applies, in a uniform way, to individual utterances and larger discourse units. It is demonstrated how the phenomenon of directionality is determined by the discourse-internal topic-comment structure.

Fundamental to the proposal is the underlying hypothesis that the topic-comment structure of discourse results from the process of answering higher-order and lower-order explicit and implicit questions in discourse. This necessarily implies a distinction between the main structure of discourse and its embedded, lower-order subordinate structures. As we will see, the former is analysed as an answer to a (set of) leading higher-order, topic-forming question(s) defining the global discourse topic, while the latter results from subquestions. By definition, substructures are hierarchically embedded in the main structure of discourse because of the specific completion function of the associated subquestions, namely to contribute to the unsatisfactory answer given to the overall, discourse-topic defining question.[6]

Directionality is then characterized as a property assigned to a discourse relation between two discourse units. According to the framework this relation is realized by an explicit or implicit topic-forming question. It will be demonstrated that dominant discourse units providing goal-satisfying values are not determined by such a question but rather by the *higher-order question* defining the common topic of both the dominant and the related non-dominant discourse unit.[7]

In Section 2, we briefly illustrate the different types of directionality that can be distinguished, and include an illustration of the fact that these types may occur on different structural levels, corresponding to the discourse-internal topic-comment structure. In Section 3, an account is given of this mostly hierarchical structure which, as indicated above, results from the process of the contextual induction of explicit and implicit topic-forming questions. Finally, Section 4 demonstrates how the different types of directionality are determined by this topic-comment structure.

2 THREE TYPES OF DIRECTIONALITY

2.1 *Description of the phenomenon*

In the introduction we have informally characterized the phenomenon of discourse directionality as the property of a (part of a) text to be directed towards a 'goal'. Usually this implies a division of this (part of the) text into two related segments, one of which is functionally less prominent. In the intentional approaches of discourse, this so-called non-dominant discourse unit is analysed as that part of the relation which is subservient to the discourse purpose associated with both discourse units, leaving unspecified the exact (intentional) status of the related dominant discourse unit.

In this paper a distinction is made between the following three types of directionality: *Forward (FW) Directionality*, *Backward (BW) Directionality*, and *Bi-Directionality*. We will demonstrate (Section 4) the specific way in which these types correspond to three different types of subordination relations in discourse. In all cases of directionality the phenomenon applies to a succession of two related discourse units. We present the following description:

FW Directionality, BW Directionality, and Bi-Directionality
Given two related discourse units $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$, the discourse relation **R** between them, $\mathbf{R}(\mathbf{U_i}, \mathbf{U_{i+n}})$, is characterized by FW Directionality if $\mathbf{U_i}$ is subservient to the succeeding discourse unit $\mathbf{U_{i+n}}$, i.e. the discourse unit that (in a sense which has to be explicated) provides the goal-satisfying value in this case, by BW Directionality if the reverse applies, and by Bi-Directionality if such a functional asymmetry is absent.

The absence of asymmetric functional relations in case of Bi-Directionality implies that the related discourse units $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$ are equally prominent and that together they contribute to the goal of the text segment which comprises the two of them.[8,9]

One of the central hypotheses of the framework to be presented is that in this context every discourse relation $\mathbf{R}(\mathbf{U_i}, \mathbf{U_{i+n}})$ is determined by an *explicit* or *implicit question* introducing the topic of the (extended) discourse unit answering this question. By definition, such a topic-forming question is induced as the result of the discourse unit $\mathbf{U_i}$ and is answered by the succeeding discourse unit $\mathbf{U_{i+n}}$. In anticipation of a further explication of this hypothesis, we will illustrate the different types of directionality in terms of discourse relations realized by such questions.

An illustration of FW Directionality is given in (1), Two implicit questions are added to the original text, providing an analysis of the structure of this text in terms of questions and answers. Angled brackets indicate the implicit character of a question; arrows indicate the direction of a discourse relation.[10]

(1) At this telephone company we assume you enjoy a good natter.

$\langle Q_1 \rangle$ ⟨What do you mean?⟩

A_1 [. . .] we've come up with an offer to make your ears prick up.

$\langle Q_2 \rangle$ ⟨What does this offer imply?⟩

A_2 It means that with this company, you can now phone all your family and friends in the UK for only 30 cents a minute, 24 hours on Saturday and on Sunday. No matter how fast they multiply in number.

FW ↓

(*The Guardian*, 10 April 1994, p. 9)[11]

FW Directionality holds for the discourse relation between the discourse units functioning as the answers A_1 and A_2. Answer A_1 has given rise to the implicit question $\langle Q_2 \rangle$ that is answered by A_2. The latter is more specific than the former. In Section 4 we illustrate that the more specific A_2 is the dominant discourse unit that sufficiently satisfies the goal of the leading implicit question $\langle Q_1 \rangle$ to which A_1 and A_2 together form an extended answer. In Section 3 we give an account of subordination relations such as that between the leading implicit question $\langle Q_1 \rangle$ and the subordinate question $\langle Q_2 \rangle$. The latter is a subquestion embedded in the extended answer given to the former.

Example (2) illustrates the phenomenon of BW Directionality.

(2) ⟨Q_1⟩ ⟨Which countries have bad records with respect to air safety?⟩

A_1 China, India, Central Africa and the republics of the former Soviet Union [. . .] are the world's most dangerous locales for air travel [. . .]

⟨Q_2⟩ ⟨Why?⟩

A_2 These countries are especially plagued by hazards such as undertrained pilots, poor air-traffic-control systems, inadequately maintained aircraft, lax airport security and political unrest.

BW

(*Time Magazine*, 11 April 1994, p. 4)

As in example (1), the implicit question ⟨Q_1⟩ is a leading question superordinating the implicit question ⟨Q_2⟩. However, in this case, it is not A_2 but A_1 that is the dominant part of the extended answer to ⟨Q_1⟩. It satisfies the goal of this question, i.e. what is ultimately being asked for by it: a list of the countries that have bad records with respect to air safety. The answer given in question ⟨Q_2⟩ merely provides support for this list.[12]

Finally, example (3) illustrates the phenomenon of Bi-Directionality.

(3) Questions about the effectiveness of therapy cloud decisions about treating the illness.

⟨Q_1⟩ ⟨What are the problems?⟩

A_1 Older patients, if left untreated for small tumors, may die of other causes.

⟨Q_2⟩ ⟨What else?⟩

A_2 [. . .] many men—young and old—face impotence and incontinence as the result of the therapy.

BW + **FW**

(*Scientific American*, April 1994, p. 2)

In line with the preceding two cases, the extended answer to the implicit question ⟨Q_1⟩ consists of the answers A_1 and A_2. However, in this example A_1 and A_2 *together* provide the requested goal-satisfying value. They constitute the enumeration of problems asked for in the leading question ⟨Q_1⟩.

Apart from the fact that an account of the questioning process underlying the structural coherence of discourse is needed, a further explanation of the phenomenon of asymmetric discourse relations is also required. As far as the latter is concerned, we will advocate the view that the discourse units involved in asymmetric discourse relations share the *same topic*, though in agreement with this asymmetry the comment value to this topic is in fact provided by only one of them.

2.2 *Operational criterion*

It is generally assumed (e.g. Mann & Thompson 1988) that an operational criterion to distinguish a functionally dominant discourse unit from a related non-dominant unit is that the latter can be deleted while preserving *discourse coherence* and *discourse intention*. Obviously, deletion of such non-dominant parts may affect, among other things, the cohesion of the text thereby implying specific adjustments in formulation, e.g. the use of definite descriptions instead of a pronoun if the latter anaphorically refers to an entity introduced in the non-dominant part.[13]

Preserving the coherence of a text implies that the structural relations between the remaining, undeleted discourse units are identical to those before deletion. In terms of the topical approach to be outlined this means that the relations between the (implicit) topic-forming questions answered by these discourse units are the same. Deleting non-subservient discourse units, on the other hand, results in *discontinuities* in the question–answer structure of the discourse.

In the developed topical approach the preservation of discourse intention in case of the deletion of subservient material implies that the higher-order and lower-order discourse purposes associated with the corresponding topic-forming questions are still fulfilled at the end of the discourse, though this deletion is in fact only possible when we assume the presence of relevant background or situational knowledge. This is obvious, for instance, with those discourse units that merely have a supportive function with respect to that which is asserted in the related dominant discourse units. Examples form those subservient discourse units that only provide a justification or motivation for the related dominant discourse unit. The essential point is that the production of this supportive material is largely addressee-dependent, i.e. dependent on the addressee's knowledge of background and situation or, in case of implicit questions, the speaker's assumptions about these. Assuming that the answer value provided by the dominant discourse unit is accepted by the addressee, the subservient discourse unit may be omitted.

An example of a specific form of deletion is that of answer A_1 in (1). A_1 (and, of course, the implicit question $\langle Q_2 \rangle$) can be omitted while the coherence and intention of the text is preserved. As a general rule, if a given answer is extended by a more specific answer, the former can be deleted because it is implied by the more specific answer. Both discourse intention and coherence in terms of question–answer structure are then preserved. Also, in a question-answer pair such as *Who are laughing?–Two women, Ellen and Susan*, the indefinite, less specific part of the answer may be deleted this way.

An illustration of another type is the deletion of answer A_2 in example (2). The non-dominant discourse unit A_2 has a supportive function only with respect to A_1 which, as long as relevant background knowledge is present, independently satisfies the goal of the leading question Q_1. Answer A_2 only provides a justification of the answer value provided by A_1.

However, in the case of example (3) neither answer A_1 nor answer A_2 are deletable. In this case an asymmetric functional discourse relation such as that in the two preceding examples is absent. A_1 as well as A_2 are functionally prominent in the sense that they provide an answer value to the leading question Q_1. Clearly, the deletion of one of them would affect the intention of the text because of the resulting incompleteness of the remaining answer.

The operational criterion to distinguish non-dominant from dominant discourse units is also important in another way. It provides an adequate explanation of the phenomenon of *summarizing* texts, i.e. those text summaries which under the assumption of specific knowledge on the part of the addressee are coherent and satisfy the same intention as the original version of the text. However, also in this case, we need a general characterization of dominant and non-dominant discourse units in order to guarantee adequate summarization.

2.3 *Directionality on different discourse levels*

Characteristic for theories of discourse structure in which directionality has a central role is the assumption that this phenomenon occurs on all structural levels. In terms of the topical approach this means that its occurrence ranges from the highest structural level that corresponds to a discourse unit for which a *discourse topic* is defined to the lowest level of individual utterances containing a *sentence topic*.[14] On each higher-order discourse level the phenomenon gives rise to the possibility of asymmetric binary relations comprising discourse units of which at least one embeds a lower-order discourse relation. As will be shown (Section 4), it is the dominant, non-deletable part of these lower-level relations that plays a role on the higher structural levels.

We will now give illustrations of the three different types of directionality realized at different structural levels in discourse, comprising both the highest structural level and all subordinate lower levels. In these examples the hierarchy of structural levels is (indirectly) represented by the given combination of arrows expressing which type of directionality is realized at which structural level.

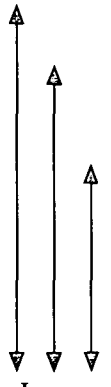
(4) $\langle Q_1 \rangle$ ⟨Why did the workers of the Philips computer division go on strike?⟩
A_1 They are very worried about the managers' new economy plans.
$\langle Q_2 \rangle$ ⟨Why?⟩
A_2 According to these plans the managers would consider moving the production section abroad.
$\langle Q_3 \rangle$ ⟨Why are the workers so worried about this?⟩
A_3 This would imply that 300 of all those employed in this division would be dismissed.

(Translation of a Dutch text)

(5) $\langle Q_1 \rangle$ How can I be sure not to miss anything on BBC World Service?
A_1 Subscribe to *BBC Worldwide* [. . .]
$\langle Q_2 \rangle$ Why?
A_2 you'll get the *full* picture every day of every month of the year.
$\langle Q_3 \rangle$ What does this mean?
A_3 As well as daily radio and TV listings; in-depth programme reviews and of course, the time and frequency details of every World Service broadcast in English, you can tune into feature articles; commentaries; reviews; worldwide reports, profiles and previews.

(*Scientific American*, April 1994, p. 11)

(6) Q_1 Whatever happened to RJ?
A_1 Six years ago, she mysteriously disappeared.
$\langle Q_2 \rangle$ ⟨Then what happened?⟩
A_2 Though the authorities had a suspect, their investigations stalled.
$\langle Q_3 \rangle$ ⟨Then what happened?⟩
A_3 Two years later her body was found in a North Coast grave.
$\langle Q_4 \rangle$ ⟨Then what happened?⟩
A_4 Now authorities have a chilling new theory about what might have happened to her.



(*San Francisco Chronicle*, 7 June 1992)

In (4) a discourse relation determined by FW Directionality is embedded in a higher-order discourse relation of the same directional type. In (5) a relation determined by FW Directionality is embedded in one determined by BW Directionality, and in the narrative presented in (6), a bi-directional

higher-order relation embeds two discourse relations of the same directional type only one of which is directly embedded.

Let us first take a closer look at example (5). The higher-order relation determined by BW Directionality is realized by the implicit question $\langle Q_2 \rangle$. It relates the discourse unit that functions as answer A_1 to the remaining discourse which forms an extended answer to the implicit question $\langle Q_2 \rangle$. The implicit question $\langle Q_3 \rangle$, on the other hand, is a subquestion of question $\langle Q_2 \rangle$. It relates answers A_2 to the more specific answer A_3, thereby constituting a FW directional discourse relation of which it will be shown that only the dominant, non-deletable part actually has a function on the higher discourse level.

As stated above, the examples (4) and (6) are different from (5) due to the fact that one or more discourse relations of one directional type are embedded in a relation of the same type. Important to mention with respect to the narrative in (6) is the assumed distinction between *event structure* and *discourse structure*. The arrows indicate that though the presentation of the events forming the story line is sequential, the underlying structure of this discourse in terms of questions and answers is hierarchical (see van Kuppevelt 1995b for more details about the analysis of narrative discourse in terms of questions and answers).[15]

In the preceding section we have discussed an operational criterion to distinguish dominant from non-dominant discourse units. Our analysis of this distinction will make clear that applying this criterion to different structural levels implies a specific computation of non-deletable values provided by dominant discourse units: the output of a deletion operation executed on a lower discourse level is taken as input for such an operation carried out on a higher structural level. The computation of these values implies that non-deletable values on a lower level may function as deletable ones on a higher level. An illustration of this is the value provided by answer A_3 in example (5). After deletion of the non-dominant discourse unit A_2, this value is taken as input for the computation associated with the deletion process carried out on the higher level which comprises the whole text (part). However, on the higher level the value provided by A_2 is a subservient one. As a final result we predict that in (5) all discourse units can be deleted except answer A_1 the value of which satisfies the goal of the leading implicit question $\langle Q_1 \rangle$.

3 THE DISCOURSE-INTERNAL TOPIC-COMMENT STRUCTURE

We will now provide an account of the phenomenon of directionality in terms of the topic-comment distinction, thereby implying a solution to both the definition and determination problem discussed above. Before starting the analysis, we will present an outline of the developed theory of discourse structure in which this distinction is central (van Kuppevelt 1991, 1995a, and other publications).

We have described directionality as the property of a higher-order or lower-order discourse relation between two discourse units, which expresses a functional asymmetry between them. In the theory of discourse structure we have developed, the hypothesis is central that the structural relations in discourse are essentially determined by the discourse-internal, mostly hierarchical topic-comment structure. It has been demonstrated that the segmentation structure of discourse corresponds to this topic-comment structure and, in particular, that this structure is the fundamental output of the process of the contextual induction of explicit and implicit topic-forming questions.[16] In this section we present an outline of this essentially *topical* approach of discourse structure.

In the succeeding Section 4 it will be shown how directionality applies to discourse structure, in particular to the discourse relations which are assumed to be primarily of a topical rather than a rhetorical or intentional nature.[17] Apart from the fact that topics are fundamental to the direction of the discourse relations, they also have another special function with respect to this phenomenon, namely, as will be argued in detail, that the nature of the direction, be it FW Directionality, BW Directionality, or Bi-Directionality, is not determined by the topic of the discourse relation involved but by the higher-order topic superimposing it.

3.1 *Topicality and underdeterminedness*

3.1.1 The uniform topic notion

The developed topical approach of discourse structure starts from a context-dependent, *question-based* topic-comment notion that accounts for the topics of sentences and those of larger discourse units in a uniform way, including those comprising the discourse as a whole. We gave the following topic-comment definition:

Definition

Every contextually induced explicit or implicit (sub)question $\mathbf{Q_p}$ that is answered in discourse constitutes a (sub)topic $\mathbf{T_p}$. $\mathbf{T_p}$ is that which is being questioned. Comment $\mathbf{C_p}$

given by answer $\mathbf{A_p}$ provides that which is asked for. If (the speaker assumes) $\mathbf{A_p}$ is satisfactory to the addressee, $\mathbf{T_p}$ is closed off. If not, $\mathbf{A_p}$ gives rise to subquestioning.[18]

Clearly, the definition merely provides a global characterization of the notions topic and comment and requires further explanation. An explication will be given by accounting for both the syntactic and semantic status of this pair.[19] Later, in particular in Section 3.2.3, we will discuss the notion of satisfactory answer.

Syntactically, a topic is analysed as expressed by the *subject term* in the grammatical analysis of both the question and the answer that is derived from it. A comment, on the other hand, is analysed as the constituent in the answer that has replaced the WH-constituent in the question. As an illustration see question Q_r in (7a) and its grammatical analysis in (7a)′.

(7) a. Q_r: Who (is the one who) has been arrested?
b. A_r: $_{TP}$[The one who has been arrested] is $_{CP}$[JOHN]
It is $_{CP}$[JOHN] $_{TP}$[who has been arrested]
$_{CP}$[JOHN] $_{TP}$[(is the one who) has been arrested]
$_{TP}$[JOHN][20]

(7)′ a. Q_r': The x [x has been arrested] by WH?
b. A_r': The x [x has been arrested] be JOHN.

In (7a)′ the topic of question Q_r is expressed by the subject term *The x [x has been arrested]*, to be read as 'The one who has been arrested'. As shown in (7b)′, all answers of (7b) are assigned the same syntactic analysis A_r'. A_r' is derived from the analysis of the question by replacing the WH-constituent by the proper answer to the question.[21]

In semantic terms, a topic $\mathbf{T_p}$ is the *intension* of the subject or topic term in the syntactic analysis of the corresponding question $\mathbf{Q_p}$. It is the contextually provided set of possible extensional values of this term which, in line with the analysis of $\mathbf{Q_p}$, is identical to the set of possible answers (comments).[22] The related comment $\mathbf{C_p}$, on the other hand, is identical to that which is asked for by $\mathbf{Q_p}$, namely the actual extension $\mathbf{T_p(S_{act})}$ of this topic term or, more generally, the extension of this term in the verification domain with which the discourse is compared.[23,24]

The topic set $\mathbf{T_p}$ thus contains possible extensions of the type meeting the description of the topic term in the question. $\mathbf{T_p}$ is contextually provided, implying that its elements are textually *given* or *evoked*. However, in many cases, knowledge of this set only consists of a *characterization* rather than an *enumeration* of its elements.

In (7)″ we give an illustration of topic set T_r, assuming that the introducing question Q_r has arisen in a context in which someone has

actually been arrested and that this context only contains the relevant set of persons D = {John, Peter}.

(7)" T_r = {⟨S_1, {John}⟩, ⟨S_2, {Peter}⟩, ⟨S_3, {John, Peter}⟩}

Topic T_r contains the extensions of the subject term 'The one who has been arrested' in all possible situations $\mathbf{S_i}$. Comment C_r, on the other hand, is that which is asked for by question Q_r, namely the extension of this term in the actual situation ($T_r(S_{act})$).[25] Important to note is that at the moment of questioning this extension is underdetermined in the discourse, implying that the extension of this term is not yet (exactly) known by all the discourse participants.

Given this semantic analysis of topic and comment, question–answer pairs are represented accordingly.

(8) $\mathbf{Q_p}$: $\mathbf{T_p(S_{act})}$ = **WH?**
$\mathbf{A_p}$: $\mathbf{T_p(S_{act})}$ = **Cp**

$\mathbf{A_p}$, forming the full answer to $\mathbf{Q_p}$, contains the proper answer to this question. It selects a possible value from the topic set $\mathbf{T_p}$ as the extension of the topic term in the actual situation.

In the semantic analysis topics are thus not identified with questions, avoiding problems comparable to those signalled by Kartunnen (1977), Tichý (1978), and others. A topic is the contextually provided set of possible values of the subject term in the syntactic analysis of the question. As will be argued in the next section, this term represents the indeterminacy that has given rise to the corresponding question. A question, on the other hand, is a request for the extension of this term in the actual situation. Identifying topics with questions would give rise to the following problems. First, it would disregard the fact that a topic is just a *part* of a questioning process. Asking a question involves both a topic set and an act of questioning, though the latter is not defined as a general request with respect to the set of possible values comprising the topic set but rather as a request for the specific value to be selected of this set. Second, the identification would imply the contextually undesirable result that a question like *Has John been arrested?* and its comparable negative version *Has John not been arrested?* are the same, because the related topic sets are identical and consist of the values that John has and that he has not been arrested.[26]

Important to note is that this semantic analysis of topic and comment explicates the relation it assumes between the two conceptually different notions of focus used in the literature, namely what is called *AI-focus* and *linguistic* or *informational focus*.[27] The latter type concerns the informationally prominent sentence part that is usually intonationally marked and that represents contextually *new information* (Sgall, Hajičová, & Benešová 1973;

Halliday 1967; Kuno 1972). The former type is assumed to be of quite a different nature and is closely related to the notion *focus of attention* commonly used in artificial intelligence (e.g. Grosz 1978; Grosz & Sidner 1986; Reichman 1978; and Sidner 1979).[28] Contrary to linguistic focus, it does not express informational prominence on the sentence level but rather referential prominence on the level of discourse. Among other things, this implies that only some of the entities introduced in the discourse are in focus of attention and, as a consequence, allow anaphoric reference. As demonstrated by these authors, the set of discourse entities in focus of attention is a variable set the content of which changes in accordance with the structure of discourse. In our framework, on the other hand, both focus notions are captured by the definition and semantic analysis of topic and comment. According to this analysis, the linguistic focus is expressed by the comment of a sentence, while the set of entities in focus of attention comprises the topic set the content of which changes radically depending on the structure of discourse. As said above, central to our framework is that discourse structure corresponds to topic structure, implying that a radical shift in topic results in the construction of a higher-level discourse segment.

Finally, the analysis of topic and comment directly gives rise to the much requested account of the relation between topics of sentences and larger discourse units on the one hand, and *discourse intentions* underlying these segments on the other. In the topical approach we have developed this relation becomes fully explicit.[29] In this approach a discourse intention is characterized in terms of topic-forming questions, namely as the requested final comment value in respect of the topic defined by the question. One of the main advantages of this approach is that the discourse intentions associated with discourse segments can considered to be directly linguistically marked, e.g. by accent distribution. This because of the existing direct relation between the linguistic form of answers and the questions asked. As will be outlined later, discourse segments of all structural levels are considered to be answers to topic-forming questions.

3.1.2 Underdeterminedness

It is assumed that the underdeterminedness of the actual extension $\mathbf{T_p(S_{act})}$ of the topic term of a question is a necessary condition for topichood. Questions are induced as the result of contextuality provided indeterminacies which, as we have seen in the preceding subsection, are expressed by the subject or topic term in the syntactic analysis of the topic-forming question. The condition for topichood implies that there is more than one entity in the world (or verification domain) talked about that meets the

description of the topic term in the question and that may function as the extension of that term in the actual situation. Though the extension of this term is defined in the world, it is underdetermined in the discourse at the moment of questioning. At that point in the development of the discourse (exact) knowledge of the extensional value does not belong to the knowledge domain shared by speaker and addressees. All that is known is that the requested extension is identical to one of the possible extensions.

The underdeterminedness of $\mathbf{T_p(S_{act})}$ is thus expressed by its relation to the original or remaining set of possible extensions $\mathbf{T_p(S_i)}$.

(9) $\mathbf{T_p(S_{act}) \in \varrho'(T_p) \qquad |\varrho'(T_p)| > 1}$

In (9) the variable set $\mathbf{\varrho'(T_p)}$ is the actual topic range of $\mathbf{T_p}$, in this case consisting of the remaining possible extensions of the topic term, thus making it a subset of the original topic range $\mathbf{\varrho(T_p)}$. As will be explicated later, $\mathbf{\varrho(T_p)}$ is reduced to $\mathbf{\varrho'(T_p)}$ if an (un)satisfactory answer to the topic-introducing question $\mathbf{Q_p}$ has resulted in the exclusion of possible extensions. As long as $|\varrho'(T_p)| > 1$, the actual topic extension $\mathbf{T_p(S_{act})}$ is underdetermined.[30] Underdeterminedness only holds if $\mathbf{\varrho'(T_p)}$ does not contain a unique extensional value, implying, as will be discussed further in Section 3.2.3, that the corresponding question $\mathbf{Q_p}$ has not yet been answered satisfactorily and will therefore give rise to subquestioning.

As for the question in example (7), (7)''' illustrates the underdeterminedness of $T_r(S_{act})$ at the moment of questioning. We start from the same assumptions, including that the contextual domain D = {John, Peter}.

(7)''' a. $T_r(S_{act}) \in \{\{John\}, \{Peter\}, \{John, Peter\}\}$

A full reduction of this underdeterminedness is realized by a satisfactory answer to question Q_r, as the result of which $T_r(S_{act})$ becomes identical to one of the possible extensions.

b. $T_r(S_{act}) \in \{\{John\}\} \qquad (|\varrho'(T_r)| = 1)$

(7b)''' shows that, in agreement with the principle of topic termination Section 3.2.3), the necessary condition for topichood is no longer met and, as a consequence, T_r is closed off.

Relevant with respect to the underdeterminedness of $\mathbf{T_p(S_{act})}$ is the related notion of *discourse informativeness*. In the framework it is presupposed that this notion is determined by answers. In the process of answering an explicit or implicit higher-order or lower-order topic-forming question an increase of informativeness results from a reduction of the underdeterminedness of the topic extension, implying a reduction of the original topic range $\mathbf{\varrho(T_p)}$ or a further reduction of the already reduced actual topic range

$\mathbf{Q}'(\mathbf{T_p})$. Reduction of a topic range results from an (unsatisfactory) answer thereby implying the exclusion of possible extensions.

3.2 *Hierarchical topic processes*

3.2.1 Feeders and main topic-forming questions

The process of explicit and implicit questioning which gives rise to a hierarchical topic-comment and corresponding segmentation structure of discourse involves the contextual induction of two functionally different types of questions, namely *main, higher-order topic-constituting questions* and *subtopic-constituting subquestions.*

By definition, topic-constituting questions are contextually induced as the result of a linguistic nor non-linguistic feeder $\mathbf{F_i}$. If $\mathbf{F_i}$ is linguistic, its function is to initiate or re-initiate the process of questioning in discourse. This process must be initiated when the context is empty, or when no more questions are induced by the preceding context and the discourse participants wish to continue the conversation. A linguistic feeder may be a single sentence, e.g. the opening sentence of a discourse, or it may be a larger discourse unit.

Together with associated background knowledge, a feeder $\mathbf{F_i}$ supplies a set of actual *indeterminacies* the inducing power of which is contextually unrestricted by preceding questions in the discourse.[31] Therefore, $\mathbf{F_i}$ provides the means to open a discourse and to initiate a discourse topic $\mathbf{DT_i}$. The indeterminacies it provides give rise to a set of main, topic-constituting questions that together constitute $\mathbf{DT_i}$.

Definition
A discourse topic $\mathbf{DT_i}$ is the set of main, higher-order topics $\mathbf{T_p}$ which have come into being as the result of one and the same feeder $\mathbf{F_i}$: $\mathbf{DT_i} = \{\mathbf{T_p} \mid \mathbf{T_p}$ originating from $\mathbf{F_i}\}$.

In a coherent discourse a feeder $\mathbf{F_i}$ gives rise to the topic of the whole discourse which usually comprises lower-order topics. If only one topic arises out of a given feeder, the topic and discourse topic coincide ($\{\mathbf{T_p}\}:= \mathbf{T_p}$).

Example (10) illustrates the contextual induction of a single topic-constituting question as the result of a feeder. The questioning process initiated by this feeder is a simple, non-hierarchical one, involving an immediate (non-stage like) determination of a requested actual topic extension (F = {x | friend(x,Harry)} = {John, Peter, William}).

(10) a. F_1 A: Late yesterday evening two friends of Harry called.
Q_1 B: Which two friends?
A_1 A: Peter and William.

b. Q_1: Which two friends?
$T_1(S_{act}) \in \{X \mid X \subseteq F \wedge |X| = 2\}.$
$\in \{\{John, Peter\}, \{Peter, William\}, \{John, William\}\}$
A_1: Peter and William.
$T_1(S_{act}) = \{Peter, William\}!$[32]

As shown in (10b), the topic-constituting question Q_1 introduces an, initially, underdetermined actual topic extension $T_1(S_{act})$. The determination of this extension is realized in a single step as the result of answer A_1.

That determination processes like that in (10) are not always realized in one step is due to, among other things, the *program* associated with a main question. A program is associated with every explicit or implicit topic-constituting question $\mathbf{Q_p}$, controlling the development of coherent discourse. It consists in the specific task, to be carried out by the speaker, of providing an answer to $\mathbf{Q_p}$ which is *satisfactory* for the addressee. As is argued in Section 3.2.3, a satisfactory answer to $\mathbf{Q_p}$ implies *unique determination* of the requested actual topic extension $\mathbf{T_p(S_{act})}$.

Main, topic-constituting questions are therefore considered to be responsible for a programmatically-bound development of the discourse. However, as indicated above, the program associated with a main question $\mathbf{Q_p}$ may not be accomplished in a single step. It is a standard procedure that such a program is realized in stages, in which case it may comprise all or a considerable part of the utterances belonging to the *main structure* of the discourse.[33]

3.2.2 Subtopic-forming questions

A programmatically bound, stage-like development of the discourse necessarily involves the contextual induction of subquestions. Subquestions introduce a topic which is subordinate to a preceding one introduced by a higher-order question. Contrary to topic-constituting questions, subquestions do not have an autonomous status in the process of questioning, but are *subservient* to the program imposed on the discourse by a leading topic-constituting question.

By definition, subtopic-constituting subquestions are contextually induced, in a *recursive* way, as the result of unsatisfactory answers and have the purpose of completing these to satisfactory answers. If a topic-constituting question has been answered unsatisfactorily and, naturally, if no disturbance of the questioning process occurs, this unsatisfactoriness gives rise to subquestions until the original main topic-constituting question has been answered satisfactorily.

Consider example (11), an advertisement, in which the entirely linear

embedding of subquestions forms a clear illustration of the recursive property of questions of this type.

(11) F_1 For more than a century and a half, *** has been known as the finest watch in the world. [. . .]
$\langle Q_1 \rangle$ ⟨What is the reason for this?⟩
A_1 It is made differently.
$\langle Q_2 \rangle$ ⟨In what way?⟩
A_2 It is made using skills and techniques that others have lost or forgotten.
$\langle Q_3 \rangle$ ⟨What kind of skills and techniques?⟩
A_3 It is made, we have to admit, with a total disregard for time.
$\langle Q_4 \rangle$ ⟨What do you mean?⟩
A_4 If a particular *** movement requires four years of continuous work to bring to absolute perfect, we will take four years. [. . .]

(*Time Magazine*, 11 April 1994)

The implicit question $\langle Q_1 \rangle$ functions as topic-constituting question. All other implicit questions form subquestions linearly embedded under $\langle Q_1 \rangle$. Each of these subquestions is induced as the result of the unsatisfactory answer given to a directly preceding one.

Subquestions thus fulfil a completion function in the program associated with a preceding topic-constituting question. We have given the following description in terms of topic underdeterminedness.

Completion function of subquestions
Given a leading topic-constituting question $\mathbf{Q_p}$, the completion function of subquestions consists in a further reduction of the underdeterminedness of the extension $\mathbf{T_p(S_{act})}$ in the discourse.

In the next two subsections we will briefly elaborate on the completion function of subquestions, making a distinction between *quantitative* and *qualitative* underdeterminedness.

3.2.2.1 Quantitative underdeterminedness

Subquestions are contextually induced as the result of unsatisfactory answers. However, this induction is caused by a quantitative or qualitative unsatisfactoriness, implying a quantitative or qualitative underdeterminedness of the main topic extension. The former type will be illustrated in this subsection, the latter in the next one.

A subquestion $\mathbf{Q_p}$ may be contextually induced as the result of a preceding unsatisfactory answer $\mathbf{A_{p-n}}$ because of the quantitative underdeterminedness of $\mathbf{T_{p-n}(S_{act})}$ implied by this answer. This quantitative

underdeterminedness presupposes that the comment value provided by $\mathbf{A_{p-n}}$ is *incomplete.*

An illustration of the contextual induction of a subquestion as the result of a quantitatively unsatisfactory answer is given in (12). In (12) question Q_2 functions as a subquestion asked as the result of the unsatisfactory answer A_1 ($C = \{x \mid \text{colleague}(x, \text{speaker A})\} = \{\text{Michael, John, Brian, Susan}\}$).

(12) a. F_1 A: Tomorrow I will go to the movies with some of my colleagues.
Q_1 B: Which of them?
A_1 A: Unfortunately Michael.
Q_2 B: Who else?
A_2 A: John and Susan.

b. Q_1: Which of them?
$T_1(S_{act}) \in \{X \mid X \subseteq C \wedge |X| > 1\}$
A_1: Unfortunately Michael.
$T_1(S_{act}) \in \{T_1(S_i) \in \varrho(T_1) \mid \{\text{Michael}\} \subseteq T_1(S_i)\}$
$\in$ {{Michael, John}, {Michael, Susan}, {Michael, Brian}, {Michael, John, Brian}, {Michael, Brian, Susan}, {Michael, John, Susan}, {Michael, John, Brian, Susan}}[34]
Q_2: Who else?
$T_2(S_{act}) \in \{X \mid X \subseteq (C - \{\text{Michael}\}) \wedge |X| \geq 1\}$
$\in$ {{John,}, {Susan}, {Brian}, {John, Brian}, {Brian, Susan}, {John, Susan}, {John, Brian, Susan}}
A_2: John and Susan.
$T_2(S_{act}) = \{\text{John, Susan}\}$!
$T_1(S_{act}) = \{\text{Michael, John, Susan}\}$!

Because of the occurrence of subquestion Q_2, the determination of the actual main topic extension $T_1(S_{act})$ is now realized in two stages. Initially, the unsatisfactory answer A_1 reduces the original underdeterminedness of $T_1(S_{act})$ to those possible extensions which include the incomplete value *Michael.* Subsequently, answer A_2 reduces the set of remaining possible extensions to one unique value, implying the determination of $T_1(S_{act})$. After an answer has been given to subquestion Q_2, both topic T_1 and subtopic T_2 are closed off. Subquestion Q_2 introduces its own subordinate topic, while continuing the main topic.

3.2.2.2 Qualitative underdeterminedness

If a subquestion $\mathbf{Q_P}$ is induced as the result of a qualitative underdeterminedness, this means that the comment value provided by the

preceding unsatisfactory answer $\mathbf{A_{p-n}}$ is either *not specific enough*, or, as will be explained later, *not yet accepted* by the addressee. An illustration of the former is given by a variant of (12) given in (12)′.

(12)′ a. F_1 A: Tomorrow I will go to the movies with some of my colleagues.
Q_1 B: Which of them?
A_1 A: Two colleagues of my own department.
Q_2 B: Which two?
A_2 A: Michael and Susan.

b. Q^1: Which of them?
$T_1(S_{act}) \in \{X \mid X \subseteq C \wedge |X| > 1\}$
A_1: Two colleagues of my own department.
$T_1(S_{act}) \in \{T_1(S_i) \in \varrho(T_1) \mid T_1(S_i) \subseteq D \wedge |T_1(S_i)| = 2\}$
$\in \{\{\text{Michael, Brian}\}, \{\text{Michael, Susan}\}, \{\text{Brian, Susan}\}\}$[35]
Q_2: Which two?
$T_2(S_{act}) \in \{X \mid X \subseteq D \wedge |X| = 2\}$
$\in \{\{\text{Michael, Brian}\}, \{\text{Michael, Susan}\}, \{\text{Brian, Susan}\}\}$
A_2: Michael and Susan.
$T_2(S_{act}) = \{\text{Michael, Susan}\}!$
$T_1(S_{act}) = \{\text{Michael, Susan}\}!$

In this case, answer A_1 is unsatisfactory, not because it is incomplete but because it is not sufficiently specific. As in the preceding example (12) the determination of the actual topic extension $T_1(S_{act})$ is realized in two stages by means of a subquestion.

3.2.3 Topic termination by unique determination

In general, if no disturbance occurs, a process of subquestioning comes to an end once the program associated with the related topic-constituting question $\mathbf{Q_p}$ is fulfilled. Program fulfilment means that $\mathbf{Q_p}$ has been answered satisfactorily, implying the unique determination of the actual topic extension $\mathbf{T_p(S_{act})}$. The principle of topic termination has been defined accordingly.

Topic termination
Once the actual topic extension $\mathbf{T_p(S_{act})}$ is no longer underdetermined, i.e. when possibly after a process of stage-like reduction the condition is met that $\mathbf{T_p(S_{act}) = C_p}$, the topic set $\mathbf{T_p}$ is no longer subject of questioning, which means that this topic and the introducing question are closed off. If $\mathbf{T_p(S_{act}) = C_p}$, $\mathbf{|\varrho'(T_p)| = 1}$ thereby implying the unique determination in discourse of the extension of the indeterminacy that has given rise to the corresponding question $\mathbf{Q_p}$.

The principle of topic termination accounts for the standard cases in which topic closure is not the result of a disturbance of the questioning process, due to, e.g., a disruption or an epistemic limitation on the part of the answerer, i.e. if he does not *know* a satisfactory answer to the leading question.

The satisfactoriness of an (extended) answer is linguistically marked by phenomena which many researchers have exclusively related to *topic closure* and *segment closure*. For instance, as far as the intonational aspects are concerned, Brown, Currie, & Kenworthy (1980) observe that topic introduction is marked by loudness and high pitch, while topic closure is marked by a relatively low pitch, by fading away in amplitude and by duration. In addition, many people have demonstrated that topic shifts on structurally different levels are intonationally marked by gradual differences in pitch accent.[36]

The state of unique determination is not always reached directly as the result of the (extended) answer given. It may be *inferred* from an apparently unsatisfactory answer. Obviously, this is only possible in the context of existing background or situational knowledge. However, other configurations in which $\mathbf{T_p(S_{act})} = \mathbf{C_p}$ are also possible (van Kuppevelt 1996a, forthcoming), namely those involving *topic-narrowing* and *topic-weakening* processes, implying a qualitative or quantitative reduction of a subtopic range as the result of the discourse purpose associated with a higher-order topic-forming question.

4 DIRECTIONALITY AND THE TOPIC-COMMENT DISTINCTION

In the preceding section we presented an outline of the developed topical approach of discourse structure, fundamental to which is the relation it assumes between the notion of topic and that of (implicit) questioning in discourse. In non-procedural terms this relationship implies the following: first, the topic of a discourse unit is defined by the explicit or implicit question it answers, and, second, the hierarchical organization of discourse segments is determined by the relations between these topic-providing questions. However, as has been illustrated, discourse structure was also dynamically characterized. By definition, main topics are contextually induced as the result of so-called linguistic or non-linguistic feeders, while the contextual induction of subordinate topics results from unsatisfactory answers, i.e. those which have not yet fulfilled that which is asked for by the corresponding question. Whereas the constitution of topics

results from the process of questioning, it is also recognized as a standard procedure of topic termination that topic closure results from the satisfactoriness of answers given. The question-based topic notion has been uniformly characterized, comprising both the notion of sentence topic and that of larger discourse units.

In this section we give an account of the phenomenon of directionality in terms of the topical approach just outlined. As stated above, directionality refers to the property of the functional asymmetry of discourse relations. It implies that, given a discourse relation between the two succeeding discourse units $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$, either $\mathbf{U_i}$ or $\mathbf{U_{i+n}}$ is the functionally prominent unit, or both are equally prominent. If $\mathbf{U_i}$ is the functionally prominent discourse unit, we speak of BW Directionality, and, inversely, if $\mathbf{U_{i+n}}$ is functionally prominent we refer to FW Directionality. In case of Bi-Directionality both units are functionally prominent and, consequently, no functional asymmetry is defined for the relation between $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$.

As for the phenomenon of directionality, we signalled two main problems, namely a definition problem and a related determination problem. In addition, we have referred to the issue of formalizing discourse units the function of which is not to provide an independent value but rather to support an already given value. The definition problem deals with the difficulty of adequately characterizing the kind of phenomenon we are dealing with, in particular the lack of an adequate explanation of the recognized differences in functional prominence. Rhetorical Structure Theory (Mann & Thompson 1988), though it provides a valuable taxonomy, does not provide a definition of this phenomenon; nor does it explain why in the case of two related discourse units one unit is functionally more prominent than the other. The intentional approaches, on the other hand, do provide a definition. However, as said above, in these approaches directionality is defined in terms of a subsurvience relation between the discourse purpose associated with the non-dominant discourse unit and that associated with both the non-dominant and related dominant discourse unit jointly. Due to this, neither the exact intentional status of dominant discourse units nor the typical relations that may exist between subservient discourse units and related dominant ones are made explicit.

In relation to the phenomenon of directionality, the topical framework outlined above is relevant in two specific ways. First, it provides a topical account of the discourse relations $\mathbf{R(U_i, U_{i+n})}$ to which this phenomenon applies. Fundamental is the view that $\mathbf{R(U_i, U_{i+n})}$ is realized by an explicit or implicit topic-forming question. This takes place in the following way: $\mathbf{U_i}$ gives rise to a topic- or subtopic-forming question $\mathbf{Q_{i+n}}$ to which $\mathbf{U_{i+n}}$ forms an (extended) answer. As can be seen from above, the discourse units

U_i and U_{i+n} may comprise discourse parts larger than a single utterance, in which case they embed lower-order discourse relations for which the property of directionality is also defined.

Second, as we will now go on to explain, the framework provides a topical account of the central notion of directionality. A discourse not only derives its structural coherence from the discourse-internal topic-comment structure, but also its directionality. Directionality appears to be an essential structural property that depends on the topic-comment structure and is assigned to discourse relations on different structural levels. The topical approach will answer the intricate question of what precisely determines which of two related discourse units is the non-deletable, functionally prominent one. In addition, it will provide a formal characterization of what this functional prominence signifies.

We can now present our definition of discourse directionality, central to which is the claim that this phenomenon is determined by topic-forming questions.

Directionality in discourse
On every structural level in discourse the phenomenon of directionality applies to two related discourse units U_i and U_{i+n} one of which is functionally dominant, except in the case of Bi-Directionality when both are functionally dominant. Functional dominance is assigned to that unit which provides (a part of) the *final comment value* to the topic defined by the higher-order (sub)topic-forming (sub)question Q_i to which U_i and U_{i+n} together form an extended answer, implying the subordinate status of the embedded question Q_{i+n}.

Together with the topical approach outlined above, the definition makes fully explicit the functional status of dominant and related subservient discourse units in terms of the topic-comment distinction. In addition, it gives rise to an explanation of the implied asymmetric functional relation between them, including the distinction we have made between the three types of directionality.

In contrast to subservient discourse units, functionally dominant units *directly* contribute to the higher-order topic-forming question to which both units jointly form an extended answer. By definition, they provide the requested final comment value to the topic defined by this question. Subservient discourse units, on the other hand, do not provide a definite value with respect to this higher-order question. Their contribution to this question is merely *indirect*, implying that their comment value is subservient to that provided by the functionally dominant unit. For instance, as will be discussed later, in case of BW Directionality the comment value provided by the non-dominant unit provides support for the definite, but not yet fully accepted comment value provided by the related dominant unit.

The definition forms the basis of an explanation of the different types of directionality in terms of the topic-comment distinction. Directionality is

considered to be a function of the different ways of quantitative/qualitative completion of an unsatisfactory answer. This implies that it is essentially a function of the three different types of subordination relations distinguished in discourse. The three types of directionality are thus explained as follows.

First, Bi-Directionality applies to a *quantitative* extension of a given partial answer, implying the absence of a functional asymmetry between the discourse unit $\mathbf{U_i}$ which functions as a partial answer to question $\mathbf{Q_i}$, and the related discourse unit $\mathbf{U_{i+n}}$ which functions as the answer to subquestion $\mathbf{Q_{i+n}}$ by means of which the quantitative extension to $\mathbf{U_i}$ is realized. $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$ together provide the final comment value to the higher-order question $\mathbf{Q_i}$.

Second, in contrast to Bi-Directionality, FW Directionality applies to a *qualitative* extension of a given answer, making it more specific. In this case the final comment value to the topic defined by the higher-order question $\mathbf{Q_i}$ is provided by only a part of the extended answer given to this question, namely by discourse unit $\mathbf{U_{i+n}}$ which is more specific than discourse unit $\mathbf{U_i}$. $\mathbf{U_{i+n}}$ functions as the qualitative extension of $\mathbf{U_i}$ which, as in the preceding case, functions as an unsatisfactory answer to the leading question $\mathbf{Q_i}$.

Finally, as is the case with FW Directionality, BW Directionality, too, involves a qualitative extension of a given answer. However, in this case the final comment value to the topic of the higher-order question $\mathbf{Q_i}$ is provided at the beginning rather than at the end of the discourse by the unsatisfactory answer $\mathbf{U_i}$. The comment value provided by $\mathbf{U_i}$ has not yet been accepted by the addressee and calls for support, e.g. a justification or motivation of the value given. This supportive material is provided by discourse unit $\mathbf{U_{i+n}}$ which forms an answer to the subquestion.

In addition to giving an adequate explanation in terms of the topic-comment distinction, the definition also provides a solution to the above mentioned *determination problem*. Given an asymmetric discourse relation $\mathbf{R(U_i, U_{i+n})}$, the relevant factor stating whether $\mathbf{U_i}$ or $\mathbf{U_{i+N}}$ is functionally dominant is thus not determined by subquestion $\mathbf{Q_{i+n}}$ that realizes the relation between them, but by the higher-order question $\mathbf{Q_i}$ to which $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$ together form an extended answer. By definition, the dominant discourse unit is the one which provides the final comment value with the topic introduced by the higher-order question $\mathbf{Q_i}$.

Clearly, this topical approach of directionality relates to the approach in terms of *discourse intentions* which, as indicated above, requires an adequate explication of the intentional status of dominant discourse units as well as an account of the specific relations between these and subservient discourse units. In the topical approach both points can be accounted for by making explicit the relation between discourse intentions and topic-forming

questions. As said above, in the topical framework the discourse intention associated with a discourse unit is defined as the requested final comment value to the topic defined by the explicit or implicit question which this discourse unit answers. The intentional status of dominant discourse units is thus captured by the fact that, in contrast to subservient discourse units, they provide the overall intentional value functioning as the final comment with the topic shared by both this and the related subservient unit. We have argued that the full acceptance of this value by the addressees may require support which is then provided by a non-dominant discourse unit. On the other hand, as will now be obvious, the intentional relations between subservient and dominant discourse units can be accounted for in terms of how their comment values contribute, directly or indirectly, to the topic of the higher-order question. As indicated in Section 3.1.1, in the topical approach discourse intentions are considered to be just one aspect, be it an integral one, of discourse structure determined by topic-forming questions.

Given the relation between topic-forming questions and discourse intentions, the definition also provides a satisfactory explanation of the *deletion property* of non-dominant discourse units. As said above, under specific conditions, subservient discourse units can be deleted while preserving discourse coherence and discourse intention. In the case of Bi-Directionality in which both the discourse unit $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$ directly contribute to the higher-order question $\mathbf{Q_i}$, neither of them can be deleted while preserving the coherence and intention of the extended discourse segment which forms an extended answer to question $\mathbf{Q_i}$. For instance, if $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$ are part of a narrative representing events that constitute the story line, deletion of one of them will affect the coherence and the intention of the text. This is, for instance, the case if in the preceding example (6) we would delete the discourse unit functioning as answer A_3. On the other hand, deletion of one of the answers in (3) would only affect the intention of that discourse because of the resulting insufficiency of the value the resulting answer provides to the higher-order implicit question $\langle Q_1 \rangle$.

In contrast to Bi-Directionality, deletion of the subservient parts of asymmetric FW or BW directional relations has no effect on the coherence or intention of the discourse. In the case of FW Directionality the more specific discourse unit $\mathbf{U_{i+n}}$ provides the final comment value, implying that not $\mathbf{U_{i+n}}$ but $\mathbf{U_i}$ may be deleted without any loss of coherence and discourse intention. Examples of deletable units in FW directional contexts are the answers A_1 in (1) and (12)'. In example (4) we may delete two units because of the occurrence of FW Directionality on two structural levels. On the lower structural level we may delete answer A_2, while on the higher level we may delete answer A_1. In case of BW Directionality, on the other hand, the

discourse unit $\mathbf{U_i}$ provides the final comment value, implying that $\mathbf{U_{i+n}}$ forms the deletable subservient discourse unit. An example is answer A_2 in (2).

Multi-level structures like the one in (5) involve both discourse relations characterized by BW Directionality and FW Directionality. BW Directionality applies to the discourse relation on the highest structural level, while a FW directional relation applies on the lower level. As illustrated above, deletion of the subservient discourse units on both levels implies that only answer A_1 remains. Also in this case, the deletion operation does not affect the coherence of this discourse which in general implies that the deletion operation has no effect on the remaining structural relations in terms of question-answer structure. Nor does the deletion operation influence the discourse intention associated with this discourse, because the final comment value to the topic defined by the higher-order question Q_1 is preserved by the remaining answer.

Finally, what still needs to be explained is how the topical analysis of directionality accounts for the formalization problem of *supportive* discourse units. Subservient discourse units of this type belong to the category of BW directional phenomena. They provide a justification, a motivation or other kind of support for that which is asserted in the related dominant part of the discourse. The problem is the formalization of the supportive function of these discourse units. Consider, in this respect, example (13).

(13) a. . . .

Q_1 B: What would be a suitable birthday present for Harry?

A_1 A: A monkey-wrench.

Q_2 B: (A monkey-wrench?) Why?

A_2 A: He recently came to borrow one from me.

b. Q_1: What would be a suitable birthday present for Harry?

$T_1(S_{act}) \in P$

$[P = \{x \mid present(x) \wedge \neg expensive(x)\}]$

A_1: A monkey-wrench.

$T_1(S_{act}) \in \{\{MW\}, \neg\{MW\}\}$[37]

$[T_1(S_{act}) = \{MW\}$ òr $T_1(S_{act}) \in Complement_P(\{MW\})]$

Q_2: (A monkey-wrench?) Why?

$T_2(S_{act}) \in R$

$[R = \{x \mid reason(x, being\_a\_suitable\_birthday\_present)\}]$[38]

A_2: He recently came to borrow one from me.

$T_2(S_{act}) = C_2!$

$T_1(S_{act}) = \{MW\}!$

As far as supportive, non-dominant discourse units are concerned, the example illustrates their reducing effect on the specific underdeterminedness that results from related dominant discourse units. In (13b) it is

illustrated that in case of positive support such an effect consists of a reduction of the following form: $\mathbf{T_p(S_{act}) \in \{p, \neg p\}}$ is reduced to $T_1(S_{act}) \in \{\{p\}\}$. The contextual induction of subquestion Q_2 indicates that the comment value provided by answer A_1 has not yet been accepted by questioner B. This means that at this stage in the process of questioning either a monkey-wrench or something else is a suitable birthday present for Harry. The answer to subquestion Q_2 lends support to the first alternative, implying the unique determination of the actual extension of the main topic (term). However, if the support given by A_2 had been negative, i.e. if $T_1(S_{act}) = \neg\{MW\}$ had been the result, this automatically would have shifted attention to the complement set of possible values: $T_1(S_{act}) \in Complement_P(\{MW\})$. In general, automatic shifts caused by negative support imply that the higher-order topic-forming question has not yet been answered satisfactorily which will then give rise to further subquestioning.

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NOTES

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2 Obviously, in the case of binary discourse relations the property of mutual subservience implies that the two discourse units involved are partially goal-satisfying. If two discourse units are mutually subservient in this respect, each of them constitutes a quantitative completion of the other only partially satisfying the goal of the question.

3 For a discussion on the characteristics of both approaches, see Rambow (1993).

4 As will become clear later, in this respect both the rhetorical and intentional approaches of discourse do in fact deal with functionally different types of subordination relations in discourse. In relation to this a distinction has to be made between the phenomenon of *subordination* on the one hand and that of *directionality* on the other. While the subordination of a discourse unit B to

a preceding discourse unit A necessarily implies that B contributes to A in satisfying the associated discourse goal, the direction of the relation between A and B may be different depending on whether B's contribution is goal-satisfying or merely goal-subservient.

5 As for the definition problem, the intentional approaches encounter other problems due to their characterization of directionality, namely in terms of the relation between a subservient discourse unit and the whole text part comprising both the subservient and the related dominant discourse unit. They face the difficulty of adequately accounting for, in intentional terms, the status of this non-subservient discourse unit as well as the difficulty of providing an account of the characteristic subservience relation between non-dominant, subservient, and related dominant discourse units. In this paper in which both issues are central we provide a topical analysis in terms of topic-forming questions.

6 We abstract from so-called *side questions* which give rise to intervening side structures. In contrast to subquestions, they do not imply a continuation of the leading topic but result from a *topic digression* (for a discussion on the main structure-side structure distinction, see van Kuppevelt 1995b).

7 In this paper the phenomenon of directionality will be only considered for cases in which a dominant and a related non-dominant discourse unit form an *uninterrupted* part of discourse (see also Carberry *et al.* 1993 on this point). However, in contrast to RST which assumes discourse relations to be primarily of a rhetorical nature, interrupted discourse relations can in principle be accounted for adequately because of the fact that the overall continuity in discourse structure is maintained. The leading (implicit) question and the topic it defines are not yet closed off and are taken up again after the interruption.

8 See also note 2.

9 The phenomenon of *multi-directionality* is analysed as a function of bi-directional relations realized on different structural levels. Examples of this phenomenon are lists (Polanyi & Scha 1984) comprising *enumerations* as well as those special cases of lists providing *event sequences* defining the story line of narrative discourse. An illustration of the latter type is given in example (6).

10 In all cases the arrows comprise both the (implicit) subquestion realizing the discourse relation $\mathbf{R}(\mathbf{U_i}, \mathbf{U_{i+n}})$ and the superordinating (implicit) question to which $\mathbf{U_i}$ and $\mathbf{U_{i+n}}$ together form an extended answer.

11 Modified version.

12 As will be argued for in Section 4, the direction of the relation between the text parts analysed as A_1 and A_2 is determined by the superordinating implicit question $\langle Q_1 \rangle$. Assigning a different interpretation to this text by changing the content of $\langle Q_1 \rangle$ may result into a different order of dominant and non-dominant discourse units. For instance, the question '*As far as China, India, Central Africa and the republics of the former Soviet Union are concerned, how bad are their records with respect to air safety?*' gives rise to an inverse relation characterized by FW Directionality.

13 Apart from the fact that deletion of non-dominant parts may result in a lack of cohesion, Mann & Thompson (1988) assume that such a deletion operation may also influence the 'grammar of clause combining'. Although the latter is considered to be of a *rhetorical* rather than a *topical* nature, in line with our topical analysis of directionality (Section 4), the authors observe that the deletion of non-dominant parts does not affect the overall topic: '[after deletion] we still have a reasonable idea of what the text is about' (1988: 268).

14 As to discourse topics, the analysis is in agreement with the observation that a discourse may contain several discontinuous discourse units that are internally coherent only in the sense that its sentences deal with the same general topic.

15 In this framework the analysis of narrative discourse as a *hierarchical* rather than a *linear* structure accounts for the phenomenon of the *structurally unrestricted accessibility* of antecedents for specific sentence-external anaphora, namely that the resolution domain of anaphora belonging to the story line comprises all possible antecedents of the part of the narrative.

16 As for addressee-oriented discourse, implicit questions are defined such as those anticipated by the speaker to have occurred to the addressee as the result of the preceding context.

17 It will be illustrated in this and the next section that the approach in terms of topic-forming questions is not unrelated to other approaches of discourse structure. It relates, in particular, to the intentional approach which accounts for discourse structure primarily in terms of the discourse purposes underlying the production of discourse.

18 Central is the point of view that topic-forming questions have a *factual* status, implying their actually occurrence in the given contexts. This discourse function of question is different to their function in so-called *question tests* (e.g. Sgall, Hajičová, & Panevocá 1986) in which they represent possible contexts in which topic-bearing sentences may occur.

19 For other question-based topic notions, see e.g. Bartsch (1976), Belnap & Steel (1976), Groenendijk & Stokhof (1993), Klein & von Stutterheim (1987), Stout (1896), Vennemann (1975), and Zeevat (1994).

20 Among other things, the presented question-based topic notion implies that a *topic-comment modulation* is imposed on every non-elliptical question-answering sentence, depending on the question it answers: *TP* is a topic part, *CP* a comment part. It is argued that comment parts are always candidates for accent assignment (capitals indicate main sentence accents). We have made use of Gussenhoven's (1984) accent rule SAAR which operates on semantic constituents often closely related to (but not necessarily implying) what is called traditional surface constituency. See in this respect, Steedman (1991 and other publications) for an isomorphism between syntactic, informational, and intonational structure based on Combinatory Categorical Grammar.

21 A grammatical treatment of question and answers is given elsewhere (van Kuppevelt 1991). As is argued in Gundel (1976), *The x* which is lexicalized as *it* in cleft sentences is not semantically empty but refers to the topic of the sentence.

22 From the viewpoint of *discourse representation*, a topic $\mathbf{T_p}$ is the set of possible extensional counterparts of the discourse address denoted by the subject term in the syntactic analysis of the topic-introducing question $\mathbf{Q_p}$.

23 In line with Hausser (1983), Scha (1983), and Tichý (1978), we have opted for an individualistic, non-propositional analysis of questions and answers. The analysis is in agreement with the view explicit in e.g. Belnap & Steel (1976) and, earlier, in Stout (1932) that the topic ('(psychological) subject') of a question is a set of *alternatives*. A topic can be taken as the set of entities referred to by that which in a given context can be inserted into the corresponding *question frame* or *open proposition* (Prince 1986) introduced by the question.

24 Obviously, the verification domain does not need to be the actual world. In this respect it is claimed that both *discourse*

coherence and *discourse satisfactoriness* are not necessarily determined by its *truth*, implying that the discourse segments functioning as answers to topic-forming questions do not necessarily provide values identical to those of the topic terms in the actual world. An extended answer may be a coherent composition of smaller, lower level discourse segments, though the latter may provide wrong answer values. Likewise, an (extended) answer may be actually wrong, but perceived by the addressee as providing the value asked for and thereby satisfying the purpose of his question.

25 The following sections will make clear that the so-called *contextualization of the topic set* implies that it is constrained not only by the domain of discourse, but also by processes of subquestioning implying a reduction of this set.

26 The second point also forms an argument against the view referred to in the first point, namely that a question is a non-specific request directed to the *whole* topic set.

27 See e.g. Vallduví (1993) on this point.

28 Clearly, the focus notion involved in Centering Theory (e.g. Joshi & Weinstein 1981) is also closely related to the notion of AI-focus.

29 See e.g. van Kuppevelt (1993).

30 Obviously, the underdeterminedness of $\mathbf{T_p(S_{act})}$ is not a sufficient condition for topic hood. The contextual induction of the topic-introducing question $\mathbf{Q_p}$ is also controlled or determined by a discourse topic $\mathbf{DT_i}$, namely in the sense that in a coherent discourse the answer to $\mathbf{Q_p}$ must also contribute to the (set of) leading question(s) defining $\mathbf{DT_i}$.

31 It was illustrated that higher-order topic-forming questions may restrict the set of actual indeterminacies associated with a discourse unit functioning as an answer to a question (van Kuppevelt 1995a). Discourse units functioning as feeders differ from such answers to the extent to which at the moment of questioning the associated set of actual indeterminacies is unrestricted by preceding questions in the discourse.

32 Topic closure is indicated by an exclamation mark.

33 For an account of the *main structure-side structure distinction*, see e.g. Klein & von Stutterheim (1987), von Stutterheim & Klein (1989) and van Kuppevelt (1995b).

34 An unsatisfactory, *incomplete answer* A_r is formally represented as $A_r{:}T_r(S_{act}) \in \{T_r(S_i) \in \varrho'(T_r) \mid C_r' \subseteq T_r(S_i)\}$, whereby C_r' is the comment value as mentioned in answer A_r.

35 An unsatisfactory, *non-specific answer* A_r is formally represented as $A_r{:}T_r(S_{act}) \in \{T_r(S_i) \in \varrho(T_r) \mid T_r(S_i) \subseteq Y \wedge |T_r(S_i)| \geq n\}$, whereby Y and n are given by A_r.

36 In this respect Hirschberg, Litman, Pierrehumbert, & Ward (1987), e.g., say the following 'When speakers increase their pitch range from one utterance to the next, they can signal varying degrees of topic change. Degree of final lowering in an utterance can be used to signal the "level" of topic which that utterance concludes; maximum final lowering signals the conclusion of major topics, for example' (1987: 637). However, see, e.g., also Hirschberg & Nakatani (1996) and Nakatani, Grosz, & Hirschberg (1995) on this point.

37 In fact the unsatisfactory answer A_1 gives rise to the *clausal implicatures* (Gazdar 1979; Levinson 1983) 'possibly p' and 'possibly ¬p', whereby p is '(That which would be a suitable birthday present for Harry is) a monkey-wrench'. The clausal implicatures give rise to the corresponding topic range $\varrho(T_1) = \{p, \neg p\}$, comprising the set of possible answer values to question Q_1. See van Kuppevelt (1996a,b) for an analysis of Quantity_1 conversational implicatures, in particular the *scalar implicatures* (Horn 1972).

38 Obviously, the sets P and R are determined by background knowledge.

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