Contributing to Coherence: An Empirical Study on O.R. Team Communication

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1 Introduction

Doctors and nurses performing a surgical operation do not only talk about their last vacation nor do they simply exchange commands and answers like "Scissors!"–"Here". They do both, but only in more routine situations. On the other hand, there are situations which demand their full attention and at the same time a fast exchange of information. In these cases, one observes sequences of discourse that are (in a way) limited in structure, but seem to be rather efficient. The question now is whether we can explain the way communication works in these specific situations with linguistic tools.

Grossly simplified, utterances are surface structures of underlying propositional structures that arise from the conceptualization of a situation. Situations as a matter of experience are comprised of categories such as events, processes or states, persons and objects such as agents or patients, as well as spatial, modal or temporal relations (cf. Levelt 1989: 74; Givón 1995: 61).[1] In an utterance, one has to refer to these categories according to preferences set by the communicational task and by the situation at hand. The addressee of the utterance has to interpret the first speaker's intention and perspective on the situation from these references. He or she then has to coordinate following actions or utterances with the—now shared—conceptualization. Successful coordination of contributions leads to coherent sequences of talk and thus to successful communication.

With Givón (1995) I assume that "coherence is fundamentally *not* a property of the produced text. Rather, that text is a by-product of the mental processes of discourse production and comprehension, which are the real loci

[1] Givón speaks of "elements that can recur across text", a notion that comes close to what will be introduced in the following, but which lacks a distinction between the conceptual level and the utterance level.

of coherence" (ibid., 60; italics by Givón).[2] But while Givón traces coherence from the product text back to the underlying processes, I want to show that these processes can be counted on to keep communication working even under highly restrictive conditions and how they do this. The principles guiding the processes shall be described in the following, and the resulting framework will then be applied to authentic data.

1.1 Framework

The general assumptions regarding utterance production introduced above have been the starting point for an extensive study on text production by von Stutterheim (1997). In this study, she organized the above categories into the following six conceptual domains:

- The domain of persons and objects as elements of predication ($r_{p/o}$).
- The domain of predications like events, states or processes (r_{ae}).
- The domain of persons and objects as parts of the predication ($r_{o/p}$).
- The domain time spans/temporal relations (r_t).
- The domain of space/spatial relations (r_l).
- The domain of modality (r_m).
  (cf. von Stutterheim 1997: 57)

Her finding is that specific communicative tasks such as instructing, describing or narrating influence the reference to the conceptual domains on the utterance level, the so-called referential filling (RF). According to the specific needs of a task, some references have to be kept stable, while others may change or may even be forced to change. This leads to certain kinds of referential movement (RM):

- Introducing a new referent for the first time and without any connection to referents previously mentioned (new).
- Maintaining reference for two or more utterances, e.g. by the same NP or by a pro-form (main).
- Resuming a reference established two or more utterances earlier (res).
- Shifting reference by introducing a new reference that is connected to a given one (shift).

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[2] I do not want to engage further in a discussion of matters of coherence, due to space limitations and because the main purpose of this paper is the presentation and discussion of empirical data.

- Limiting reference by choosing a specific reference out of a set of given ones (limit).
- Extending reference as the opposite to limitation (ext).
- Summing up maintained or restored references in a single expression (sum).
  (cf. von Stutterheim 1997: 63–64)

This approach comes close to concepts of principle organization of information in texts like "maintenance of reference" (Labov 1972, Marslen-Wilson et al. 1982), but it provides a more detailed framework. In a way it is an elaboration of Givón's definition of "coherence as continuity"[3] and it simplifies his requirements for "coherence as grounding" (Givón 1995: 64), because it allow for the identification of parts of the produced text as belonging to the main structure of the text—those that follow the conditions for the filling of the conceptual domains as required by the task—as well as side structures that do not fit into the general pattern—and therefore are less, if at all, coherent—but which may serve different communicational needs.

By the means of RM and RF one can then distinguish two kinds of coherence: static coherence and dynamic coherence (cf. von Stutterheim 1997, 30–33). Static coherence arises from those referential fillings that have to be kept stable for the whole text. They have a frame-setting function and do not necessarily have to be spelled out. The dynamic coherence arises from general ordering principles or a "principle of linearization" (Levelt 1981) that governs the sequential ordering of information in the text. This can either be the chronological/temporal ordering of events or a spatial ordering as e.g. by the "imaginary tour" as described in Linde & Labov (1975).

Empirical studies by von Stutterheim (1997) and von Stutterheim & Kohlmann (1998) showed that this framework allows for generalizations about the production of certain text types. However, these have been carried out in more or less monological settings, i.e. there have been clearly defined speaker-hearer roles with a communicative imbalance towards the speaker. For the purposes of this study I assume that the general findings of this framework can be transferred to dialogical situations as well. My hypothesis is that we rely on these processes not only as a planning device during utterance production, but also as a means of interpreting the utterances of partners in communication. In section 2 I will apply the above framework to empirical

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[3] "Coherence is the continuity or recurrence of some element(s) across a span (or spans) of text" (Givón 1995, 61).

data. The following discussion will show the limitations of this transfer, and offer suggestions for necessary expansions.

1.2 Database

The data discussed in this paper stem from roughly 30 hours of real-life surgical operations in a general hospital in Münster, Germany and a cancer hospital in Berlin. The operating room sessions were recorded on videotape and MD, and were subsequently transcribed by the author. The examples presented in this paper all are from one operation, an abdominal tumor resection. Participants in the parts presented here are a male operating surgeon (CO), a male assistant to CO (CA), a female resident (CP), and a female theater nurse (CI). These parts are taken from the record with the identification number II/02/99/A+B.

2 The Operating Room Data

2.1 Static and Dynamic Coherence in the Data

Static and dynamic coherence are the result of planning processes in monological utterance production. In order to successfully transfer the RF/RM-framework to conversation, it has to be shown that both types of coherence can also be created in cooperation between the partners in conversation. Of course, we cannot suppose that the interactants communicate in any way that they are going to apply to the upcoming sequence of conversation, such as e.g. the linearization principle. In the following example, (1), I want to demonstrate how these types of coherence are then achieved.[4] Table 1 gives an overview of the referential fillings and movements in this sequence of conversation.

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[4] Abbreviations/Signs and Symbols:

spObj	specified object	poss	possibility
nec	necessity	imain etc	implicitly ...
t_0	time of utterance		
< >	comments and their reach	[ ]	overlap
?	rising intonation	.	slightly rising intonation
-	constant intonation	:	slightly falling intonation
.	deeply falling intonation		
=	latching of turns, within a sound: two syllables		
( )	inaudible or, if filled, presumed words		

(1) 001 CO kannst du mir die cava weghalten?=
           can   you me the cava keep away?
    002 CA =ja. sofort.
           yes. immediately.
    005 CO <<leiser> hm jets isse weg; hm? (   )>
           <<lower>> hm now is it gone; hm? (   )>
    006   da fehlt noch n stück.
           there misses still a piece.
    007 CA (zustimmendes murmeln)
           (affirmative murmur)
    008 CO da kommt noch n mast; ja?
           there come still a mast; yes?
    009   oder is das (neuro)?
           or   is this(neuro)?
    010 CA das kann sein.
           that can be.
    011   das geht dich vielleicht gar nichts mehr an; ne,
           that's perhaps no concern of yours; right,
    012 CO [meinste?
           [sure?
    013 CA [(das vielleicht vorher der Punkt).
           [(that perhaps previously the point).

This turn-sequence is opened by a question. References in nearly all conceptual domains are new, except those to persons, i.e. to CO and CA.[5] The following summarizing utterance by CA could have been a closing turn, but in line 3 CO signals further need of information. Here the reference to the caval vein is restored in $r_{p/o}$ from $r_{o/p}$ in line 1. This reference is then kept stable until the closing of this sequence, mostly by maintenance or resumption. So in this case, the reference to $r_{p/o}$ is a source of static coherence. This is due to the fact that the caval vein is the object under discussion, because of its location is unclear.

A different picture arises in the domain r_{ac}. Here no coherence can be stated at all, since a permanent change of states of affair has to be discussed. The domain $r_{o/p}$ and the domain of modality also play a minor role for coherence. The first mostly serves to introduce new objects. The function that references to the modal domain have must be discussed later.

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[5] I will regularly assume reference to team members as "restored", since they should be salient to the participants in the conversation.

line	$r_{f/o}$	r_{ae}	$r_{o/p}$	r_i position	starting point	path	goal	r_r	r_m
001	CA	event	spObj,P		from x				poss
	res	new	new,res		new				new
002		event						t_{0+n}	fact
		sum						new	ires
005	spObj	state			from			t_0	
	res 001	new			res 001			res	imain
006		state		deikt					imain
	limit 005	new		shift005					
007									
		(sum)							
008	spObj	event		deikt					
	main 005	new		main					
009		state	spObj						
	main	new	new						
010		state							poss
		sum							new
011	spObj	state							poss
	res 009	new							main
012									poss
		main/sum							main
013		state						$t<t_0$	poss
	res 011	new						new	main

Table 1. First line: referential filling; Second line: referential movement. Implicitly maintained references are only spelled out once.

Of more interest for matters of coherence are the spatial and the temporal domain. In the spatial domain, reference to the starting point of the requested action is introduced, restored as the action has to be continued, and finally shifted by deictic means to a neighboring point. Spatial relations thus are fixed along the way of the vein and along spots identified in relation to it. References to the spatial domain then in this case are a matter of dynamic coherence.

In the temporal domain, reference is mentioned explicitly in three cases. Those in lines 2 and 13 will be discussed below. In line 3, the restoration of the time of utterance as the temporal reference is made explicit. In the following utterances, this reference has to be understood as implicitly shifted from the time of utterance of one utterance to that of the next one. Temporal reference in conversation is thus a matter of dynamic coherence by definition, and any diversion from this track has to be made explicit and be justified.

Coherence in this piece of naturally occurring conversation indeed results from certain patterns of referential movement. But unlike the monological situation, referential movement here is achieved by a cooperative effort of the participants in conversation. In a sequence of conversation, each participant links the filling of conceptual domains in his own utterance to that of the preceding utterance by keeping up the references established there and/or by adding new information through a shift in reference. Completely new information has to be embedded in such a referential structure.

2.2 Typical Patterns of Coherence and Further Functions of RF and RM

This section serves to examine whether the observations made in section 2.1 are arbitrary or whether they allow for some generalizations. It has been shown that certain kinds of coherence are related to the referential filling of certain conceptual domains in this type of natural conversation. I will now take a closer look at the single domains in some other examples in order to demonstrate that this finding is not accidental. Furthermore, I would like to show that RF and RM may serve additional conversational functions in cases in which they do not seem to be directly related to matters of coherence.

In the domain $r_{p/o}$, maintenance or subcategories like resumption, extension or limitation are dominating, and static coherence is the result. Introducing new references in this domain or shifting them within a sequence will lead to disruptions in communication, as can be shown in example (2), which again is schematized in table 2.

(2) 027 CO müsst ich den mit dem finger unterkriegen, ne?
           should I that with the finger hold from below, right?
    028   (7sec)
    029 CA <<sehr leise> das (rot) muss noch dazwischen>;
           <<very quietly> that (red) has to be in there between>;
    030   (2sec)
    031 CO <<sehr leise> sonst mach ich n clip drunter noch>; ne?
           <<very quietly> otherwise put I a clip there below it>; ok?

line	$r_{p/o}$	r_{ae}	$r_{o/p}$	r_l position	starting point	path	goal	r_t	r_m
027	CO res	event new	spObj new	below new				t_0 ishift	nec new
029	spObj new	event new		btwn/dei ext				t_0 ishift	nec main
031	CO res	event new	SpObj new	below/dei res				t_0 ishift	poss new

Table 2.

Here, CA tries to establish a new object reference after a longer pause, but this does not fit into the conceptualization of the situation that led to CO's utterance in 027. Thus, CO ignores this new reference and instead introduces a new one in $r_{o/p}$ within the frame he himself set in 027. Nevertheless, this sequence is coherent in a way, since the spatial references are kept stable. This however does not save CA's intentions. His object reference does not occur again after that. So static coherence in this domain seems to be a rather strong requirement.

(3) 096 CO overhold-
    097 CI mit mit faden gleich?
           with with thread at once?
    098 CO egal-
           I don't mind-
    099 nee. nee. einfach nur (overhold/ohne).
           No. no. simply only (overhold/without).
    100 ich will se ja erstmal hochheben; weißte?
           I want to it first raise; you know?
    101 CI mhm
    102 (3sec)
    103 CO kannst du einen setzen?
           can you set one?
    104 CA was willst du jetzt?
           What do you want now?

line	$r_{p/o}$	r_{ae}	$r_{o/p}$	r position	starting point	path	goal	r_t	r_m
096			spObj new						
097		state new	ishift						
098		imain							poss new
099		shift	limit						
100	CO res	event new	spObj res				upwd new		purpose new
101		sum							
103	CA res	event new	spObj res 096						
104	CO res	event new	Obj new					t_0 res	purpose new

Table 3.

The domain $r_{o/p}$ seems to be complementary to $r_{p/o}$, as example (2) indicates. It allows for the introduction of new references without endangering the overall success of the utterance. But there seem to be some restrictions to this, as can be seen in example (3) and table 3. above. In line 103 CO tries to restore reference to the object introduced in line 096 without success, as CA's question in line 104 indicates. Obviously, CO supposes that CA shares his conceptualization of the situation and that he has been following the conversation from the beginning, which is not the case. He also does not take the intervening side-structure in line 100 into account. So for CA, the references in line 103 are completely new references. The elliptic structure is not specific enough to introduce them.

No function in respect to coherence can be assigned to the domain r_{ae}. Here, mostly new references occur. These are events, such as actions to be taken or certain states under discussion. This domain is therefore of high informational value.

The domain of spatial relations is open to dynamic as well as static coherence. The former has been described in the discussion of example (1), the latter can be seen in lines 027–031 of example (2).

As has been previously stated, temporal relations are by definition a matter of dynamic coherence. Usually reference to this domain does not emerge in the surface structure. Explicit mentioning of temporal reference

serves specific functions. In example (4)/table 4., CO uses the explicit temporal reference to coordinate CA's and his own upcoming activities:

line	r_{po}	r_{sz}	r_{ep}	r_n position	starting point	path	goal	r_t	r_m
120	CA res	event new	spObj res118						poss new
121	CO res	event new	spObj res	down new				after 120 shift	poss main
125	CA res	event new	res118					before 121 shift	purpose new
127	CO res	event new	spObj new					after 125 shift	fact res

Table 4.

(4) 120 CO mir wär recht wenn du die machen könntest.
              It would be all right with me if you this could do.
     121   dann kann ich das präparat runterhalten. ja?
              then can I the specimen keep down.   yes?
     123   (3sec)
     125 CO [<<leise> willst du die erst machen?>
              [<<low> do you want to do this one first?>
     127 CO (ich dann nachher) (nerv rüberziehen?)
              (I then afterwards) (nerve pull across?)

Besides this function of organizing team activities, references in the temporal domain may serve discourse organizational functions, as well. Explicit mentioning of reference to time characteristically occurs in openings of sequences, as e.g. in line 5 in example (1)[6], which then receives more attention from the interactants. Another sign of discourse organization by temporal reference is found in line 013 in example (1), where CA adds the explicit temporal reference "previous to t_0" to his utterance in order to mark the state of affairs as a fallback in the temporal ordering, and thus irrelevant for the situation at hand.

References to modality[7] are factual in most of the cases here and they are implicitly maintained. Explicit mentioning of references to modality may be

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[6] Actually, one should speak of a kind of re-opening in this case, since line 2 could have been a closing turn.

[7] For a detailed discussion of modality see Dietrich (1992).

treated similarly to those in the temporal domain, because they occur in the same parts of conversation sequences. In the openings of sequences, reference to modality directs attention to desired actions, and thus justifies the start of a turn-sequence, as shown e.g. in lines 027 and 120/121 in examples (2) and (4). Closing sequences are also frequently marked by the occurrence of modal references. In lines 011-013 in example (1), CA offers a possibility, which CO tentatively accepts in summing up the references in line 012. In line 013, CA then repeats his suggestion, which—in interaction with the temporal reference—leads to closing.

conceptual domain	$r_{p/o}$	r_{ae}	$r_{o/p}$	R_1	r_t	r_m
RM	main, res	new	new, res	shift	Shift	main

Table 5. Preferences for RM.

We can now state that there are some preferred types of RM in this kind of conversation. Departures from these preferences are either connected to specific functions of discourse organization, or lead to disruptions in conversation. The overall types of referential movement can then be summed up as in table 5 above.

3 Conclusion and Future Goals

The analyses of the operating room data have shown that coherence can indeed be traced back to mental processes. The framework of referential fillings and referential movement that I adopted from a theory of speech production primarily designed for situations of monological speaking proved to be adequate for dialogical data as well. But whereas in a more or less monological situation we can assume that individual planning processes are at work, this cannot be the case in the same manner in multi-party conversation. However, because there are nevertheless processes like RF and RM traceable in these data, an equivalent to the planning processes must exist, which controls the way the utterances of the various speakers are linked.

The ratio of this way of utterance linkage can possibly be explained using Clark's (1996, inter alia) notion of conversation as a joint activity that sets off from a certain point of shared knowledge and aims at accumulating common ground (Clark 1996: 39). For the situation in the operating room we can assume that the interactants share a broad common ground due to their

professional skills, the clear-cut borders of the field of operation, and the highly standardized environment. Therefore, applying knowledge about the regular proceedings of surgery may replace planning processes as a principle of linearization.

This and the observed interaction between RF/RM and discourse organisation, which may most promisingly be examined in relation to pragmatic framework, such as those succeeding from Sacks snd Schegloff's (1973) work for example, must be the basis for further research in this field based on the introduced premises.

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