Establishing coherence in dialogue: sequentiality, intentions and negotiation

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Abstract

Communication in everyday conversation requires coordination both of content and of process. While the former has been studied extensively, there has been a paucity of studies on the latter. This paper addresses the question of how sequences of talk are established and sustained. We present evidence from a series of maze-game experiments that raise fundamental questions concerning the basic coordination mechanisms that are involved in this process.

1 Introduction

Dialogue, the primary site of language use, is fundamentally part, and constitutive of everyday social settings. Interaction situated in these settings is underpinned by constraints on expected and permissible contributions which provide the foundation of interlocutors' meaningful exchange and effective coordination. An important component of this foundation consists of the *sequential organisation* of interleaved utterances and actions over multiple turns by different speakers.

Sequential organization of interaction is perhaps most apparent in formal settings that require strict adherence to a protocol of prescribed steps, e.g. religious ceremonies or court proceedings (Atkinson and Drew 1979). However, dialogue research has revealed that sequential organisation is a principal means of achieving coordination in everyday conversation too, e.g. making requests, or entering and exiting phone conversations, (Schegloff 1979).

A common thread running through these studies is the recognition that the unit of analysis required for examining these phenomena must be sensitive to the relationship *between* turns (Drew 1997). In Conversation Analysis (CA), the role of turn-taking is emphasized as a locally managed interactional system employed by interlocutors to coordinate their conversation. CA analyses show that the sequential organisation of turn-taking is the basis for establishing two types o*f coherence*: (a) it manages the orderly distribution of contributions, but also (b) it coordinates content: the sequential relationship between turns provides important constraints on utterance interpretation. In Clark's *grounding model* (1996), this approach is extended: a key concept is the *joint proje*ct, which embeds verbal interaction within the more general concept of *joint activities*, thus deriving the constraints on the sequential organisation of interlocutors' contributions from the analytic structure of the common goals that are pursued.

However, there are two main issues that arise in these approaches: (a) Despite these studies' close analysis of how particular dialogue trajectories unfold during interaction, there has been a paucity of studies that directly address how *ad-hoc sequential organization* emerges, becomes established and is maintained (b) Existing models of dialogue provide conflicting accounts of which mechanisms are employed by interlocutors to achieve the development of sequential organisation.

1.1 Development of sequentiality

In empirical investigations within CA, coordination is established by interlocutors' turn-by-turn displays of their construals of each other's utterances. The structure underpinning such displays is the conversation analytic notion of *adjacency pairs*. CA investigations show how interlocutors' utterances demonstrate acute sensitivity to the unfolding sequential nature of the dialogue (Schegloff 1972; Drew 1997). Here the emphasis is placed on the coherence relationships among turns which is based on *conditional relevances* set up among contributions: production of the first part of an adjacency pair creates an expectation that the second half will occur. Any response will then be interpreted as pertaining to the second half through a system of inferential significances set up by this expectation. This locally managed turn-coherence system results in global coherence through the hierarchical interleaving of embedded sequences that take care of local problems and disturbances by means of, e.g., clarification and elaboration (Levinson 1983; Clark 1996).

However, as CA's main objects of study have been single stretches of talk, such investigations seem to have neglected the interleaving of talk with action and the conditional relevances established in the domain of joint activities in general (Clark 1996). Moreover, as a methodological premise, CA analyses concern "naturally occurring" dialogue as their primary data, rejecting experimental manipulation to probe specific predictions (Schegloff 1992). As a result, CA research has typically treated adjacency pairs as static objects, already shared by interlocutors, and, hence, has not been led to any systematic investigation of how they might develop during conversation.

1.2 Coordination mechanisms

Existing accounts of dialogue differ in their emphasis on which mechanisms are involved in coordination and how their systematic deployment affects the course of dialogue. Formal approaches to dialogue that operate under standard Gricean assumptions (e.g. Grosz and Sidner 1986; Cohen et al 1990; Poesio and Traum 1997; Poesio and Rieser 2010) see the formulation of determinate intentions/plans and their full recognition as the main causal mechanism underlying dialogue comprehension and production. Performance in joint tasks then relies on the coordination of (joint) intentions/plans through negotiation and grounding that establish mutual beliefs and common ground. Similar prominence to explicit negotiation is also given by the grounding model. Here, the role of *coordination devices,* the basis for interlocutors' mutual expectations of each other's individual actions, (Clark 1996; Shelling 1960) is emphasised. Alterman (2001) also argues for the value of explicit negotiation in the achievement of coordination.

In contrast, Garrod and Anderson (1987) observe that explicit negotiation is neither a preferential nor an effective means of coordination. If it occurs at all, it usually happens after participants have already developed some familiarity with the task; even when a particular approach to the task is explicitly negotiated and agreed by the participants they do not seem to persevere with it for long. The Interactive Alignment model developed by Pickering and Garrod (2004) emphasizes the importance of *tacit co-ordination* and *implicit common ground* achieved via the psychological mechanism of priming. However, this model does not appear ideally suited to account for the development of sequential organisation: the establishment of *routines*[1] and the significance of repair as externalised inference are noted by Pickering and Garrod but it is unclear how these mechanisms could be extended straightforwardly to capture sequential structures that span multiple turns and organise the performance of the whole joint activity.[2]

To address these issues concerning the mechanisms that are implicated in the emergence of sequential structure and the significance of the coordination devices interlocutors employ, we draw on the results of a series of maze-game experiments. In all of these experiments, participants collaboratively develop sequences of steps to solve the mazes, thereby providing a helpful means for analysing how sequential structure becomes established.

2 Methods

The experiments employ a modified version of the "Maze Game" devised by Garrod and Anderson (1987). This task creates a recurrent need for pairs of participants to co-ordinate on procedures for solving the mazes.

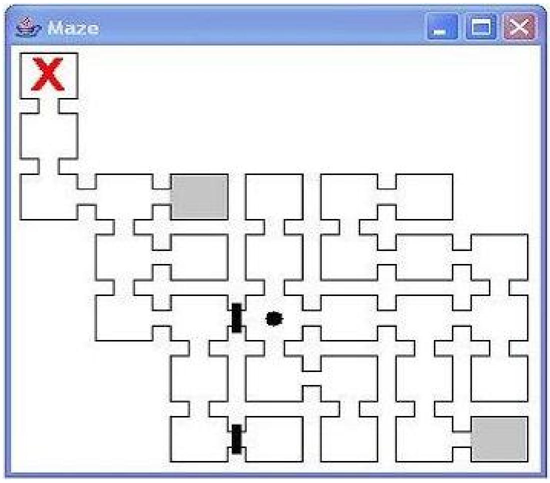

Fig 1: Example maze configuration. The black circle shows the player's current position, the cross represents the goal point that the player must reach, solid bars the gates and grey squares the switch points.

[1]However, see Poesio and Rieser (2010) for an attempt to reformulate their intentional account in terms of routinisation.

[2]Garrod and Anderson's (1987) *principle of input/output co-ordination*, even though intended as a simple heuristic to replace explicit negotiation, also does not seem to account for the development of sequential organisation. This is because its primary focus is on how single conventions, typically a referring expression or descriptive scheme, become established through successive use. It is unclear how this could be extended to capture sequential structures that span multiple turns.

2.1 Materials

2.1.1 Maze Game

The maze application displays a simple maze consisting of a configuration of nodes that are connected by paths to form grid-like mazes (see Fig 1). The mazes are based on a 7x7 grid and are selected to provide both grid-like and asymmetric instances. Participants can move their location markers from one node to another via the paths. Each move is recorded and timestamped by the server. The game requires both subjects to move their location markers from a starting location to a goal. Although the maze topology is the same for both subjects, each subject has a different starting location and goal, neither of which are visible to the other subject. They are also not able to see each other's location markers. Movement through the maze is impeded by gates that block some of the paths between nodes. These gates can be opened by the use of switches (grey coloured nodes). The locations of switches and gates are different on each maze and are not visible to the other participant. Whenever a participant moves to a node that is marked as a switch on the other's screen, all of the other participant's gates open. All the gates subsequently close when they move off the switch.

This constraint forces participants to collaborate: in order for participant A to open their gates, A has to guide B onto a node that corresponds to a switch that is only visible on A's screen. Solving the mazes (i.e. when both participants are on their respective goal positions) requires participants to develop procedures for requesting, describing and traversing switches, gates and goals.

2.1.2 Chat tool interface

Participants communicate with each other via the use of a novel text-based experimental chat tool (Healey and Mills, 2006). All turns generated by the participants pass through a server that allows for the introduction of artificial turns that appear, to participants, to originate from each other.

2.2 Participants and Design

56 pairs of native English speakers participants were recruited from undergraduate students and were assigned to one of three conditions (*baseline*, *clarification requests*, *reduced sequentiality*). In all conditions, dyads played 12 randomly generated mazes.

Baseline: 11 dyads served as control group. No experimental interventions were performed.

Dual window (reduced sequentiality): 18 dyads were assigned to this condition. Participants used a variation of the chat-tool design similar to Anderson et al. (2000). This version directly interferes with the sequential coherence of the unfolding dialogue by separating the chat-text into two separate windows that only display chat-text from a single participant, thereby prohibiting any interleaving between turns (see Fig 2, below).

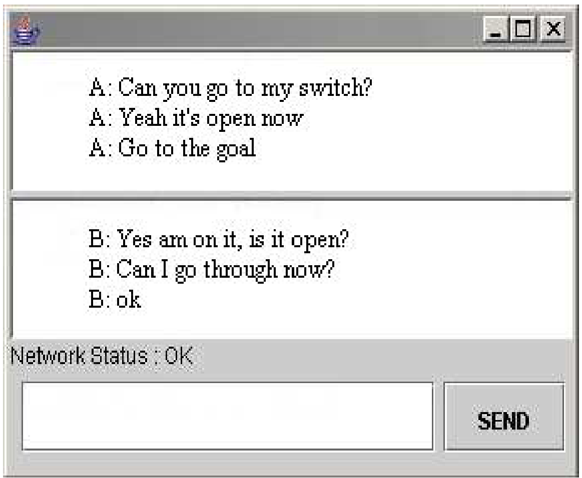

Figure 2: Dual window chat tool. Each half only displays text from one participant.

Artificial clarification requests: 26 dyads were assigned to this condition. Every (+/-) 35 turns, the server randomly generated artificial clarification questions (probe CRs) that appeared, to participants, to originate from each other. Overall, 219 clarification requests were generated. Participants' responses to probe CRs were recorded for analysis and were not relayed to the other participant. After receiving a response to the CR, the server sends an artificial acknowledgement turn ("ok", "ok right") to the recipient and resumes relaying subsequent turns as normal.

The clarification questions were of two types: Reprise Fragments ('**Frags**') that query a constituent of the target turn by echoing it and '**Whats**' (e.g., "what?", "sorry?", "Ehh?", "uhh?") that query the turn as a whole. The excerpt below illustrates a typical fragment clarification sequence:

A:	I'm at the top	*Target turn*
B:	top?	*Artificial turn by server*
A:	yes	*Response by A*
B:	thanks	*Artificial ack. by server*

3 Results

3.1 Sequentiality

To test whether reduced sequential coherence makes the emergence of procedural co-ordination more problematic, all turns in the baseline and reduced sequentiality conditions were classified with respect to procedural '**co-ordination points**' (Alterman and Garland 2001). These are defined as points in a joint activity when participants are interacting with each other in order to develop a common course of action. Co-ordination points here where coded if they mentioned "switch", "gate" or "goal". To provide a measure of the difficulty of establishing procedural co-ordination, the log files were used to calculate the typing speed (characters per second) and the number of edits (deletes per character) at these co-ordination points (See Fig 3 below).

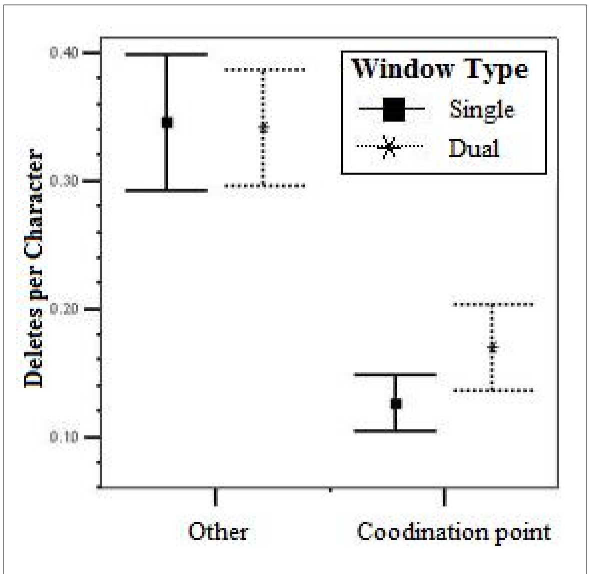

Figure 3: Turn formulation difficulty (Deletes per character) for turns that mention "switches", "gates", "goals" (Coordination point).

Focusing on co-ordination points, subjecting the number of edits to a one way ANOVA, with Window type (dual/single) as between-subjects factor yielded a significant main effect of decreased sequential coherence on number of edits ($F=4.69$, $p <0.05$) and also on turn formulation time ($F= 4.01$, $p < 0.05$). Interfering with sequential coherence increases turn formulation time (11.6 vs. 10.5 characters per second) and results in more self-editing (0.12 vs. 0.17 edits per character).

By contrast, for turns that did not explicitly mention "switch", "gate", "goal", no effect of reduced sequentiality was found on typing speed ($F=0.13$, $p=0.17$), or edits ($F=0.012$, $p=0.91$).

3.2 Intention recognition

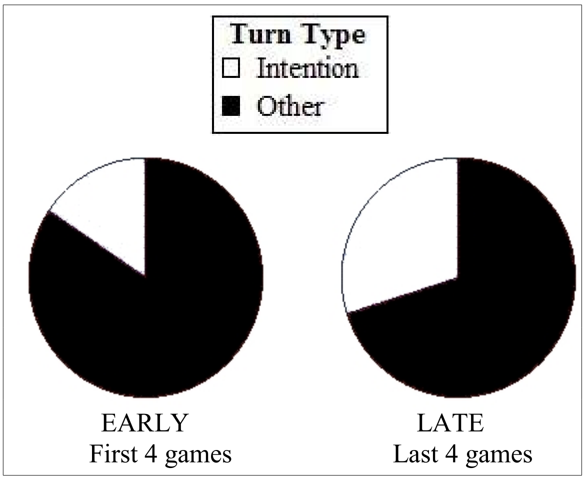

Figure 4. Proportion of CR responses that clarify intentions in first 4 games and last 4 games.

To test the necessity of plan/intention recognition for grounding utterances, participants' responses to clarification requests (CRs) were coded for whether they were construed as concerning the underlying intention of the queried turn, e.g., "you have to go there to open my switch" or "so that my gate opens". All things being equal, if plan/intention recognition is essential to establishing coordination, participants should clarify plans and intentions more frequently in the early stages of the game than in the late stages when the plans have become more established. Comparing participants' responses in the first 4 games with responses from the last 4 games yields the opposite: as task experience increases, participants' responses to clarification requests use significantly more explicit disambiguations concerning "intentions", (chi^2 (1, $N=219$) = 6.3, $p <0.01$) (see Fig 4 above).

3.3 Explicit negotiation

To examine the role played by explicit negotiation, the first mazes in all conditions were coded for attempts to explicitly negotiate the sequence, for example, "first you go through the gate, then I get on the switch and then you tell me when you're through". Examining these attempts yielded no dyad that was able to establish such a sequence through explicit negotiation alone.

4 Discussion

The results outlined above[3] present a problem for existing accounts of dialogue that rely on intention-recognition/planning: At the start of the experiment, participants must interact with each other on how to develop procedures for solving the mazes. However, examination of the data suggests that this interaction does not involve straightforwardly articulated negotiation in the form of plans and intentions (see also Garrod and Anderson 1987). Instead, participants seem to develop gradually and spontaneously a structured solution to the coordination problem the maze game presents, a solution, moreover, which is consistent across pairs of participants.

To illustrate how participants become progressively more coordinated without relying on explicit negotiation, we focus on how their exchanges become progressively structured. For reasons of space, we will examine in parallel what effects this structuring has on coordination as far as interpretation of turns is concerned.

4.1 Embedding moves in sequences

4.1.1 Effects on interpretation

In all three maze game conditions, as observed in previous maze game studies, interlocutors frequently take more than 120 turns to solve each maze (Mills, 2007). However, by the 12th maze, interlocutors develop *sequences* of highly formulaic, elliptical, fragmentary utterances, with very complex context-dependent interpretations (see e.g. fragments 1,2 and 4,5 in Excerpt 1 below). For example, consider a typical full exchange from one of the later games:

1)	**A:**	1,2 2,6 1,4
2)	**A:**	5,6
3)	**B:**	4,5 3,4 7,1
4)	**B:**	1,4
5)	**A:**	4,5
6)	**B:**	1,2
7)	**A:**	4,5

Excerpt 1: Highly elliptical dialogue from late stages of maze game

However, participants are able to unproblematically deal with these fragments, as in these later stages of the experiment, they have developed adequate procedural expertise which allows them to navigate the task with minimal conversational exchange. Of great interest at this stage is the absence of any explicit requests, confirmations or feedback.

In contrast, at a slightly earlier stage, the dialogues are less elliptical:

1)	**A:**	I have switches at 1,2 2,6 1,4
2)	**B:**	Where's your goal?
3)	**A:**	5,6
4)	**B:**	mine are at 4,5 3,4 7,1 can you get to any of them?
5)	**A:**	I can get to 4,5, can you get to any of mine?
6)	**B:**	I can get to 1,2
7)	**A:**	I'm on 4,5 you can go through now..
8)	**A:**	go to your goal
9)	**B:**	Done

Excerpt 2: Less elliptical dialogue from late stages of maze game

Here it is much more apparent what the sequential import of each turn is: in addition to referring to spatial locations, the interlocutors have developed a highly structured joint project for solving the mazes, consisting of the following sub-projects:

1. State (and request) location of switches
2. State (and request) location of goal
3. Signal accessibility
4. Move onto switch
5. Other moves through gate
6. Move onto goal

In the light of this structure we can now interpret Excerpt 1 as demonstrating how the sequence of steps has become sufficiently established (*routinised*) to obviate the need for any explicit indication of what each turn is "doing". Depending on an utterance's sequential location within the joint project, the Cartesian co-ordinate fragments in Excerpt 1 will be taken to refer to a switch, a goal, or to a participant's current location in the maze. Further, the utterance's sequential position also determines whether the mentioned co-ordinate is a request for the other participant to move to that location, a confirmation of having moved to a location, a statement where they are currently located, or where they are blocked (see Excerpt 3 below).

[3] Note that despite the difference in modality, results obtained using the chat-tool interface have been shown to replicate results from the original verbal task (see e.g. Healey & Mills 2006).

4.1.2 How structure emerges

The sequence in Excerpt 2 appears deceptively simple: it is a straightforward exchange consisting of spatial descriptions, requests, confirmations. Despite this apparent simplicity, the results show that the interlocutors are unable to arrive at this sequence through explicit negotiation.[4] Instead, it is arrived at via a series of longer, less elliptical, sequences of turns. Excerpt 3 below shows a typical immediately prior stage in the development of the joint project:

1)	**A:**	I have a switch at 1,2
2)	**B:**	I can't get there
3)	**A:**	how about 2,6?
4)	**A:**	If you go to any of them they will open all of my gates
5)	**B:**	ok, can get to 2,6
6)	**A:**	Go
7)	**B:**	Is your gate open?
8)	**A:**	yeah...thanks..where are your switches?
		(similar to sequence above, but for opening B's switches)
21)	**A:**	My goal is at 2,3
22)	**A:**	I can get to 4,5
23)	**B:**	ok. can you go there to open my switch?
24)	**A:**	yeah..am on it now..is your gate open?
25)	**B:**	yeah, are you through?
26)	**A:**	yeah
27)	**B:**	can you get to your goal?
28)	**A:**	yep..am on goal
29)	**B:**	I'm stuck on 2,3..go back...I need to get through a gate that is between me and my goal..
30)	**A:**	where do you need me to go?
31)	**B:**	can you get to 4,5 and then reach your goal?
32)	**A:**	yeah, shall I go there?
33)	**B:**	go
35)	**B:**	done

Excerpt 3. Less elliptical maze game dialogue.

[4] Note that the setting differs from Foster et al (2009), hence the distinct results: both participants here, even though instructed of the general goal of the task, do not initially know what the problem involves and what strategy they should develop to deal efficiently with it.

Space considerations preclude showing the preceding exchanges, since for the first few mazes games frequently take over 150 turns. Nevertheless, global inspection of the data shows that there is no "shortcut" -interlocutors must pass through stages of progressively refining and shortening the sequence they develop.

Importantly, this phenomenon of "telescoping" of sequences of actions is orthogonal to the contraction of referring expressions on repeated use (Krauss and Weinheimer 1975; Brennan and Clark 1996). This certainly does occur, e.g. (1,2) is a contraction of "1 across 2 along", which in turn is a contraction of "1 across from the left and 2 down from the right".[5] However, in the excerpts shown above, the progressive contraction of the sequences (telescoping) is a global pattern of developing *coherence* that operates over whole spates of talk that amount to the resolution of a single maze. Further, the data strongly indicate that this contraction is not simply the verbal exchange becoming shorter and more structured. Instead, it can be seen that by the end of the round of games played, all turns have become moves in a game involving both utterances and actions. Each move projects a next move, and implicitly confirms completion of a prior move (i.e. *conditional relevances* have developed). This, as explained below, can be discerned by the participants' responses to the fake CRs generated through the experimental manipulation.

4.2 Effects of high vs. low co-ordination

Closer examination of the data collected reveals a differential pattern in CR responses in early vs. late games. During the first few mazes, when the participants are relatively inexperienced in the task, CRs are interpreted in familiar ways (Purver 2004; Ginzburg and Cooper 2004; Schlangen 2004) as querying the referential import of the constituent concerned:

1)	**A:**	5, 6
2)	**Server:**	what? / 5?
3)	**A:**	5 across, 6 along counting from the left hand side of the maze

Excerpt 4: Clarifying referential import

At late stages of the interaction though, CRs are more likely to be interpreted as questioning what the target-turn as a whole "is doing" in the sequence (see Drew 1997). Here both fragment

[5] See also Garrod and Anderson (1987) and Healey (1997) for an account of the semantic development of spatial descriptions in the maze game.

and "What" CRs are interpreted significantly more frequently as concerning the intention or plan behind the target utterance:

1)	**A:**	4th square along
2)	**Server:**	what? / 4th?
3)	**A:**	because you've got to go there / you asked me to go there.

Excerpt 5: Clarification request interpreted as querying intention/plan

1)	**A:**	5, 6
2)	**Server:**	what? / 5?
3)	**A:**	that's where I'm blocked, can you get me out of there?

Excerpt 6: Clarification request interpreted as querying intention/plan

Responses to these CRs reveal the participants' projected analysis of the structure of the joint project into "moves" (sub-projects) through their explicit identification of the purpose of the target turn. This shows that at these late stages of the interaction when sufficient coordination has emerged, participants are able to formulate explicitly the plans and intentions underlying their actions and utterances. This contrasts with earlier stages, where participants seem unable to formulate such plans as the underlying causes of their actions, compounded by the observation that, even when participants attempt to co-ordinate in this way, more often than not, these attempts prove unsuccessful. This result is compatible with Ginzburg's (2003) observations that show, on the basis of corpus research, that recognition of underlying plans and intentions is not necessary for grounding .

Looking then at the aetiology behind the development of the joint project (as illustrated by Excerpts 1, 2, 3), these results seem to suggest that such intentions and plans emerged from interaction, and did not precede it. This is substantiated by the observation that explicit negotiation over developing a sequence of steps for solving the maze is more likely to impede and be ignored in the initial stages:

1)	**A:**	OK, first you've got to tell me where to go and then I can go through
2)	**B:**	where are your switches?
3)	**A:**	tell me where to go so I can get through
4)	**B:**	I'm blocked by the gate in front of me

Excerpt 7: Failure at explicit co-ordination

4.3 Effects of sequentiality on coherence

The data strongly suggest that in both early and late stages in the development of joint projects and their associated moves, *sequentiality*, that is, the possibility of setting up conditional relevances between utterance pairs, plays a key role as the progenitor of co-ordination.

On the one hand, in the later stages of the maze game, highly elliptical exchanges (telescoping) as illustrated by Excerpt 1 are fully reliant on sequential position for their interpretation due to each move in the fully-formed joint project projecting completion of some prior and also projecting the relevant next move (*coherence*). On the other hand, in the early stages of the maze game, while the nascent joint project is still vaguely defined, interlocutors may still rely on explicit mentions of *coordination devices* like "switch", "gate", "goal". As shown by the results obtained in the reduced sequentiality condition (Dual window), at these stages, disruption of the sequential organisation can be seen to have detrimental effects on coordination: interfering with adjacency of turns has an adverse effects on negotiating these "co-ordination points" (see Figure 3).

4.4 Conclusions

These results appear to undermine accounts of co-ordination that rely on an a priori notion of (joint) intentions and plans (see also Clark 1996) and also accounts which rely on some kind of strategic negotiation to mediate coordination (e.g. Alterman 2001 who claims that explicit negotiation is the "co-ordination mechanism" par excellence to deal with coordination problems). Instead, according to the the data, participants, at initial stages of the task, employ a minimal amount of explicit attempts at coordination, and these attempts are either ignored or fail. This and the pattern of differential CR interpretations (early vs late) strongly suggest that planning and intention-recognition are mechanisms only successfully employed at late stages, once interlocutors are sufficiently coordinated. These observations seem consonant with an alternative approach to planning and intention-recognition according to which forming and recognising such constructs is an activity subordinated to the more basic processes that underlie people's performance (see e.g. Agre and Chapman 1990; Suchman 1987/2007). Taken cumulatively with the finding that reducing sequential coherence makes procedural coordination more problematic, the results here strongly suggest that the tacit co-ordination mechanisms of turn-by-turn feedback in dialogue provide a richer set of resources than those possible in attempts to describe and resolve co-ordination problems explicitly.

Acknowledgments

This work is supported by an individual Marie Curie IOF fellowship (2010-2012) Grant no.: PI-OF-GA-2009-236632-ERIS, DiET (EPSRC /D057426/1), DynDial (ESRC-RES-062-23-0962). We gratefully acknowledge advice and support from Pat Healey, Ruth Kempson, Matt Purver, Chris Howes, Arash Eshghi.

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