Chapter 11
Effective Coordination in Human Group Decision Making: MICRO-CO: A Micro-analytical Taxonomy for Analysing Explicit Coordination Mechanisms in Decision-Making Groups

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Abstract In this chapter we present a taxonomy we have developed for assessing coordination mechanisms during group decision-making discussions (MICRO-CO). Since there is a convincing number of findings on poor-quality outcomes of human group decisions and tragic examples found in politics (e.g. Bay of Pig invasion of Cuba), there is an escalating need to foster quality group decision making, particularly with regard to group coordination. Especially for ordinary, daily work-group decision processes (e.g. in project teams; during personnel selection), the current state of scientific research does not offer conclusive explanations of how group members communicate in order to coordinate information exchange and decision making. This research question seems interesting given the growing number of decision-making guidebooks for practical use. In recognition of this need, we have developed MICRO-CO, applying theoretical as well as data-driven methods in order to more decisively study the effectiveness of coordination mechanisms for group decision making. It consists of 30 categories organised in three main and four medium levels, with inter-rater reliability testing resulting in

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substantial to very good agreement. We also report initial experiences using MICRO-CO and discuss its limitations and benefits.

11.1 Introduction

Do you remember your last board or project meeting where you had to come to a decision within your group? Unfortunately, as you may confirm, the process of joint decision making seems to be a challenging endeavour and human group decisions are far from perfect (Kerr and Tindale 2004; Stasser and Titus 1985). Reasons for poor human group decision quality stem from (1) an inadequate exchange of information relevant to the decision (Larson et al. 1998a; Mesmer-Magnus and DeChurch 2009; Stasser and Titus 1985), (2) an insufficient evaluation of the possible negative consequences of ego-based or predetermined decision preferences (Gigone and Hastie 1993; Greitemeyer and Schulz-Hardt 2003; Kauffeld 2007a, b; Schauenburg 2004), and (3) an inappropriate integration of different information, leading to a lack of consensus and delaying possible decisions (Nijstad 2006). These findings represent Steiner's (1972) notion postulating that actual group productivity is a function of both the potential group productivity and process losses occurring during the group interaction. Process losses emerge through a malfunction of motivation and coordination (Stroebe and Frey 1982). By concentrating on the latter, the question arises as to how human groups can be effectively coordinated during their decision process in order to minimise process losses and to optimise decision quality simultaneously. Even if we knew the precise demands during group decision making and the potential mechanisms to meet those demands, we still need to study their effectiveness. Studying coordination in human decision-making groups requires measurement tools that allow for assessing the *quality* of coordination processes during group decision-making discussions.

In this chapter we present a micro-analytical taxonomy for analysis of coordination mechanisms in decision-making groups (MICRO-CO). It allows us to (1) measure coordination mechanisms used by group members during decision-making discussions, and thus also to (2) compare effective and ineffective decision-making groups with regard to their explicit coordination behaviour. As will be outlined, effective group decision making requires a high degree of explicitness; MICRO-CO therefore particularly focuses on explicit coordination mechanisms. Compared to existing taxonomies of group processes, MICRO-CO permits a detailed analysis of the coordinative function of statements made during group discussion, for example, by distinguishing among seven types of steering questions. The coding system operates on the micro-level of verbal interaction behaviour based on the premise that, especially in tasks of high complexity, coordination is performed via communication (Reimer et al. 1997).

This chapter is organised as follows: In a first step, we briefly explain the coordination demands of human group decision tasks. Afterwards we present the taxonomy for group decision coordination mechanisms, and we then close with a

discussion of both the advantages and challenges of MICRO-CO plus further research needs.

11.2 Coordination Requirements During Group Decision Making

Why and how does group decision making involve coordination? We will focus on the particular characteristics of decision-making tasks (e.g. structuring the process, information requirements, evaluation demands), as this seems a promising method for predicting teamwork requirements (see Chap. 6).

11.2.1 The Nature of Group Decision Tasks

We propose that the conflictive nature of human group decisions and their opaque structure (McGrath 1984), the high information and evaluation demands, as well as social, affiliative, and hierarchical sources of information (Gouran and Hirokawa 1996) lead to very high requirements for coordination. As suggested by Hirokawa (1990), human group tasks can be analysed with regard to three characteristics: structure, information requirements, and evaluation demand. By applying these characteristics to the group decision task, it becomes apparent why human group decision making must be coordinated (Boos and Sassenberg 2001; Kolbe and Boos 2009):

1. Group decision making is a complexly structured process because its goals and means of goal achievement are often part of the decision-making task itself. Establishing a consensus between individual and group goals and matching individual task representations to a shared mental model of the decision task must be achieved as a basis for joint work.
2. The inherent information requirements of group decisions are very high in most cases, because initial information is typically unequally distributed between group members, making a final high-quality decision possible only via shared and integrated information. Without appropriate coordination, these inherent clarification, reconciliation, and information integration qualities of human group decision making tend to result in poor information processing. For example, relevant information often either is not mentioned (Stasser and Titus 2006) or gets lost during discussion due to not being repeated, summarised, or otherwise stored (e.g. Kolbe 2007). Given that most human decision-making groups consist of different experts, and therefore of different views of problems or standards, simply sharing information is not sufficient. In addition, the meaning of the shared information often needs to be reconciled (e.g. Waller and Uitdewilligen 2008).

3. The evaluation demands of group decision tasks are set very high, because the correctness of most human group decisions cannot be determined objectively. This requires that diverse individual opinions, preferences, and evaluation criteria need to be discussed (Boos and Sassenberg 2001) and that the initial ambiguity of information needs to be clarified (Poole and Hirokawa 1996).

Given these high coordination demands of human group decision tasks, we will outline in the next section mechanisms of human group coordination and reveal how they led to the creation of MICRO-CO.

11.2.2 Coordination of Group Decision-Making Discussions

We regard human group coordination as the task-dependent management of interdependencies of group tasks, members, and resources by regulating action and information flow (see Chap. 2).

Wittenbaum et al. (1998) considered coordination in task-performing groups a concept with two dimensions. The first dimension refers to the point of time when the coordination mechanism is applied (prior to vs. during the actual interaction). The second dimension refers to the degree of explicitness (see Chap. 4 for a full description). Explicit coordination is mainly used for coordination purposes and, by definition, is expressed in a definitive and unambiguous manner. Statements of explicit coordination leave almost no doubt regarding their underlying purpose, and the coordination intention of an explicitly coordinating group member is often recognised as such by other group members. In instances of implicit coordination, human group members anticipate the actions and needs of the other group members and adjust their own behaviour accordingly (Rico et al. 2008; Wittenbaum et al. 1996). Contrary to explicit coordination, implicit coordination mechanisms typically do not use clear and conclusive behaviours. Instead, coordination is reached tacitly through anticipation and adjustment.

Considering the extremes of these coordination dimensions leads to four simplified modes of group coordination (1) preplans (pre-interaction and explicit, e.g. ‘time scheduled for group discussion’), (2) in-process planning (interaction and explicit, e.g. ‘summarising opinions’), (3) tacit pre-coordination (pre-interaction and implicit, e.g. ‘unspoken expectations and behavioural norms’), and (4) in-process tacit coordination (interaction and implicit, e.g. ‘providing task-relevant information without being requested to do so’) (Wittenbaum et al. 1998).

Given the process character of human group decision making and the coordination losses that occur during the decision process (Steiner 1972), we will now focus on explicit and implicit in-process coordination mechanisms used during the decision-making process. How can both be effective for group-decision making? The potential effectiveness of implicit in-process coordination lies in (1) its time-saving manner, and (2) its strategic potential for elegantly steering the process by circumnavigating recurrent orders or requests that could result in feelings of inappropriateness or redundancy, as professional group members generally do not

wish to be 'directed' or feel that their intelligence or know-how is discounted or disrespected. However, effective implicit in-process coordination requires the participating group members to have an accurate and shared idea of the decision task, procedure, and interaction. Such shared mental models have been defined as group members' knowledge structures enabling them to form accurate explanations and expectations of the task (Cannon-Bowers et al. 1993) and have been classified as an implicit, pre-process coordination mechanism based on the four-cell Coordination Mechanism Circumplex Model emerging from Wittenbaum's mechanism concept (Wittenbaum et al. 1998; see also Chap. 4). If an accurate and appropriately shared mental model does not exist among the involved decision partners, relying on mere implicit in-process coordination can fall short of coordination needs (e.g. van Dijk et al. 2009). In line with this, Wittenbaum et al. (1998) postulated that implicit coordination alone would be ineffective in complex and interdependent tasks. They suggested that divergent goals and intentions, unequal information distribution, and ambiguity of opinions and preferences require – as is typically the case during group decision making – increased levels of explicit in-process coordination. As such, explicit coordination can be considered most important at the beginning of the interaction, as it facilitates the development of shared mental models and thus facilitates later implicit coordination (Orasanu 1993) (see also Chap. 10). The advantages of explicit in-process coordination are its directness and clarity. Even though being explicit requires communicative effort and time and sometimes courage, the trade-off is that it enhances comprehensibility, transparency, and unambiguousness. An interview study focusing on subjective coordination theories of experienced group leaders and facilitators has shown that explicitness is typically used for instructions (e.g. suggesting a procedure for decision making; asking somebody to provide information), process structuring (e.g. goal definition, making and using notes), and fostering shared cognition via clarification questions, solution questions, and procedural questions. It is also considered vital for 'setting the tone' in terms of defining communication rules (Kolbe and Boos 2009). Taken together, it appears that the demands of the decision-making task benefit from a certain amount of explicit in-process coordination.

The relationship among task demands, explicit coordination, and group performance has been well investigated in high-risk work environments. For example, Grote et al. (2010) have found that in cockpit crews, explicit in-process coordination and crew performance were positively correlated. Similarly, medical research has recently focused on the role of group coordination in ensuring patient safety (Künzle et al. 2010; Manser et al. 2008; Rosen et al. 2008; Zala-Mezö et al. 2009) (see also Chaps. 5 and 6). For example, the lack of explicit in-process coordination in the form of questioning decisions and/or by notifying other group members of critical events has been generally found to be a main source of error (Greenberg et al. 2007; Hyey and Wickens 1993).

For ordinary, daily work-group decision processes (e.g. in project teams; during personnel selection), however, the current state of research does not allow conclusions to be drawn about how group members communicate in order to explicitly coordinate information exchange and decision making, which is interesting given

the growing number of guidebooks for practical use (e.g. Bens 2005; Edmüller and Wilhelm 2005; Hartmann et al. 2000; Hunter et al. 1995; Kanitz 2004; Seifert 2005; Wikner 2002). We do know that group moderators apply their knowledge about group functioning and their attitudes towards coordination mechanisms when using explicit coordination mechanisms according to perceived task requirements (Kolbe and Boos 2009). But we do not yet know whether this is relevant for optimal group decision performance. Drawing on the functional perspective of groups (Hackman and Morris 1975; Wittenbaum et al. 2004), there appears to be an escalating need to study the effectiveness of using explicit coordination mechanisms during group decision making within the process and for the overall decision outcome, and in turn to investigate whether explicit coordination mechanisms help to avoid common mistakes such as not mentioning, not repeating, or failing to store decision-relevant information (Kolbe 2007; Stasser and Titus 2006).

In addressing these research needs, we present a micro-analytical taxonomy for the analysis of coordination mechanisms in decision-making groups (MICRO-CO). Given the relevance of explicitness during group decision making as outlined earlier, MICRO-CO focuses primarily on explicit rather than implicit in-process coordination mechanisms.

11.3 MICRO-CO: A Micro-analytical Taxonomy for Analysis of Explicit Coordination Mechanisms in Decision-Making Groups

In this section we explain the analysis of group coordination by means of interaction analysis and describe the taxonomy as well as the related coding procedure.

11.3.1 Micro-analytical Interaction Analysis

The goal of the coordination taxonomy is to assess mechanisms used for coordination during group decision-making processes. A coordination mechanism is defined as a statement or action by which group coordination is executed during interaction, whereby the interdependencies of tasks, members, and resources by regulating action and information flow are managed (see Chap. 2). As stated earlier, the focus of MICRO-CO is the assessment of explicit in-process coordination.

Group coordination in decision making can be analysed by means of interaction analysis (see Becker-Beck 1994, 1997; Becker-Beck et al. 2005; Boos 1996; Boos et al. 1990; Brauner 1998; Brauner and Orth 2002; Hirokawa 1982; Kerr et al. 2000; Marks et al. 2001; McGrath et al. 2000; Nägele 2004; Tschan 2000; Weingart et al. 2004; Wittenbaum et al. 2004). We developed this taxonomy based on (1) findings of an explorative study (Kolbe and Boos 2009), (2) videotaped group decision-making discussions of an experimental study (Kolbe 2007), and (3) the formal

model of group coordination (see Chap. 2). This model suggests that, based on a coordination occasion, a specific coordination mechanism is used, which in turn is followed by a certain consequence. Applying the formal coordination model requires the detailed description of coordination actions, as well as their prerequisites (coordination occasion) and their proximate consequences. This can be done by micro-analytically coding the coordination utterances of the group members. The term 'micro-analytical' refers to the level of fine-grained analysis of statements of individual group members during interactions.

11.3.2 Taxonomy of MICRO-CO

The taxonomy of MICRO-CO consists of three main categories: explicit in-process coordination, content-related statements, and additional categories (Fig. 11.1).

As suggested in the literature on coding system development (e.g. Brosius and Koschel 2001; Früh 2004; Weingart 1997), we developed the taxonomy in a theoretical as well as data-driven way (see Table 11.1). With regard to theory, we referred to (1) the formal model of group coordination (see Chap. 2), (2) the literature on group coordination and group interaction analysis (Beck and Fisch 2000; Gottman 1979; Grote et al. 2003; Hirokawa 1982; Kauffeld 2007a, b; Larson et al. 1998b; Simon 1997; Yukl 2002) and (3) findings of a study on subjective coordination theories (Kolbe and Boos 2009). This led us to an initial taxonomy, which we tested for usability and reliability, and we then adapted it in a subsequent iterative procedure using five transcribed group decision-making discussions of a previous study (Boos 1996).

The main category of explicit in-process coordination includes four medium-level categories with respective categories whose source will be explained in Table 11.1: 'addressing' (personally and by name); 'instructions' ('asking sb. to do sth.', 'assigning tasks or responsibilities', 'suggesting procedure', 'asking sb. to clarify sth.', 'asking sb. to suggest sth.', 'reminding sb.'), 'structuring' ('summarising', 'repeating', 'goal setting', 'goal indicating', 'deciding', 'explaining own behaviour'), and 'questions' ('requesting information', 'requesting opinion', 'requesting clarification', 'procedural questioning', 'requesting solution', 'requesting agreements', 'requesting decision'). The content-related statements include 'declaring', 'providing information', 'providing opinion', 'agreeing', 'disagreeing', 'content-related suggesting', and 'suggesting solution'. Finally, there are two additional categories: 'interrupting' and 'one-word focusing statements' (Fig. 11.1). A detailed description of these categories, including examples, can be found in Table 11.1. For example, the category 'explaining own behaviour' belongs to the medium-level categories structuring (see first column), which in turn belongs to the main-level category 'explicit in-process coordination' (see vertical row). It is defined as a person who makes his or her manner or attitude (in which he or she behaves) clear or comprehensible. An example would be, 'I will now tell you the pros and cons of this procedure'. The last column of Table 11.1 shows that this category was

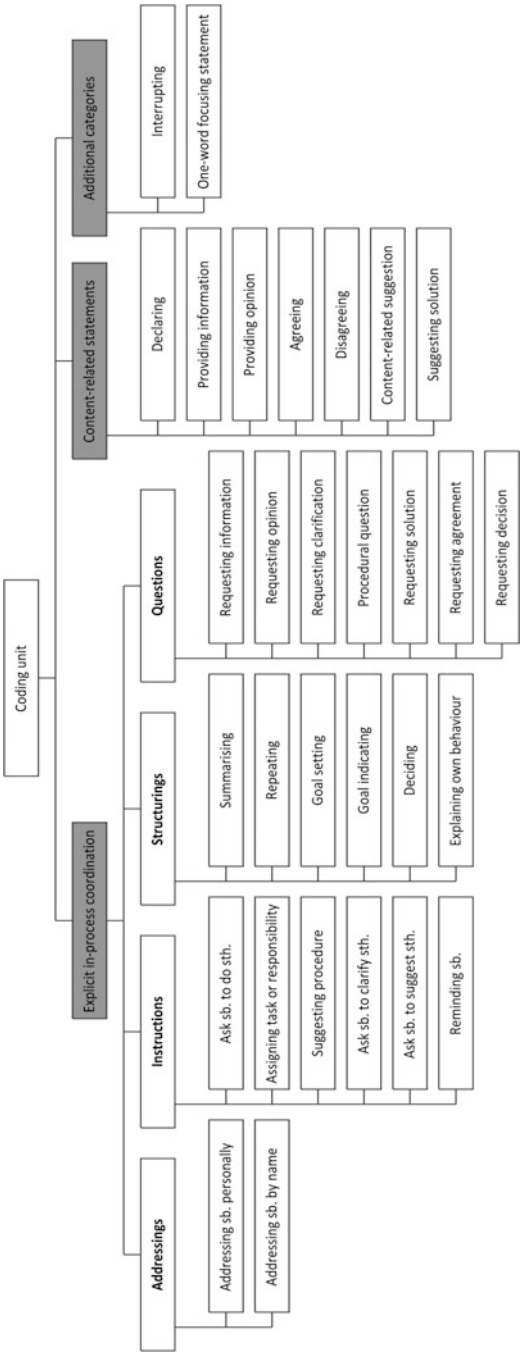

Fig. 11.1 Micro-analytical taxonomy for analysis of coordination mechanisms in decision-making groups (MICRO-CO)

Table 11.1 Definitions, examples, and sources of MICRO-CO categories

Main- and medium-level category	Category	Definition	Example	Source
Explicit in-process coordination				–
Addressing	Addressing sb. Personally	The person who talks speaks to someone directly in order to give him or her instructions	'This falls into your area of expertise'.	Data-based
	Addressing sb. by name	The person who talks approaches someone directly by using his or her name in order to get his or her attention (e.g. by using the first or last name)	'Steve, would you please explain your point of view?'	Data-based
Instructions	Ask sb. to do sth.	Someone directs a request for something at someone	'Would you please hand out the write-ups?'	Grote et al. (2003), Yukl (2002), Kolbe and Boos (2009)
	Assigning tasks or responsibilities	Someone allocates or gives out tasks or delegates responsibilities to someone.	'It's your job to make sure the process runs smoothly'.	Yukl (2002), Kauffeld (2007a)
	Suggesting procedure	Someone proposes a series of steps which should help to accomplish a task	'Let's first listen to everyone's opinion before coming to a conclusion'.	Fisch (1998), Simon (1997), Kauffeld (2007a), Kolbe and Boos (2009)
	Ask sb. to clarify sth.	A person requests that someone makes his or her statement clearer and easier to understand in order to eliminate confusion or uncertainty	'Please illustrate your suggestion'.	Simon (1997), Yukl (2002)
	Ask sb. to suggest sth.	A person tries to induce someone to come up with an idea in order to start a process by which one thought leads to another.	'Could someone offer an idea of how to solve this problem?'	Simon (1997), Yukl (2002)

(*continued*)

Table 11.1 (continued)

Main- and medium-level category	Category	Definition	Example	Source
	Reminding sb.	Someone causes another to remember something. He or she puts something back into his or her mind	'We must keep in mind that we have to solve this problem by the end of the day'.	Yukl (2002), Kolbe and Boos (2009)
Structuring	Summarising	Someone gives a recapitulation of salient facts	'To sum up the situation it has been said that. . .'	Grote et al. (2003), Kauffeld (2007a)
	Repeating	Someone repeats or reinforces something already said. Therefore he or she expresses him- or herself in the same way or with the same words	Person A: 'We should take a look at our law enforcement!' Person B: 'Yeah, we should [take a look at the law enforcement]!'	Kolbe and Boos (2009), Larson et al. (1998b)
	Goal setting	A technique leading to the assigning and choosing of specific, objective, concrete targets or goals which one or more members of the group strive to achieve	'We have to figure out who is going to do what in order to solve this case!'	Kolbe and Boos (2009), inductive
	Goal indicating	Someone points out or shows the way to or the direction of where the discussion is supposed to end and what results they want to achieve	'I think if we find some clues to such-and-such we'll be able to solve the puzzle'.	Data-based
	Deciding	Someone is able to determine the outcome and therefore reaches a decision	'I've reached a decision on how we go from here...'	Kolbe and Boos (2009), Simon (1997)
	Explaining own behaviour	A person makes his or her manner/attitude (in which he or she behaves) plain or comprehensible	'I will now tell you the pros and cons of this procedure'.	Kolbe and Boos (2009), data-based

Questions	Requesting information	A person asks someone to share their knowledge or facts and data they've collected on the subject	'Haven't you read something about this lately? What was it about exactly?'	Grote et al. (2003), Kauffeld (2007a), Fisch (1998), Simon (1997)
	Requesting opinion	A person asks someone for his or her belief/judgment based on his or her special knowledge	'What do you think about this suggestion?'	Kauffeld (2007a)
	Requesting clarification	A person asks someone to explain or clarify a certain aspect of the discussion	'What exactly are you suggesting?'	Simon (1997), Kolbe and Boos (2009), Yukl (2002)
	Procedural question	A person asks someone to specify exactly what has to be done and in what order so everyone knows what series of steps have to be taken to accomplish an end	'How do you suggest we proceed from here?'	Kauffeld (2007a), Fisch (1998), Kolbe and Boos (2009)
	Requesting solution	A person requests an answer to the current problem	'Would someone like to suggest a solution?'	Kolbe and Boos (2009), data-based
	Requesting agreements	A person suggests reaching a harmonious consensus in order to come to terms on the subject	'Are you all OK with this decision?'	Grote et al. (2003), Simon (1997), Kolbe and Boos (2009)
	Requesting decision	A person asks someone else to reach a conclusion or make up one's mind	'Would someone please share the conclusion they've reached?'	Simon (1997)
Content-related statements				–
	Declaring sth.	A person makes a full statement.	'Never underestimate anybody!'	Fisch (1998)
	Providing information	Someone presents/lays out his or her knowledge or a collection of facts or data	'This law is about the rights of all citizens'.	Fisch (1998), Kolbe and Boos (2009), Grote et al. (2003)
	Providing opinion	Someone reveals/gives away his or her beliefs or judgments	'I don't think that's such a good idea because we shouldn't	Fisch (1998)

(*continued*)

Table 11.1 (continued)

Main- and medium-level category	Category	Definition	Example	Source
			forget to include everyone on this matter'.	
	Agreeing	Someone comes to terms about a thing and reaches a mutual understanding	'We are on the same page when it comes to how to solve this'./'I absolutely agree with everything you've said'.	Fisch (1998), Kauffeld (2007a), Gottman (1979)
	Disagreeing	Someone has a different opinion about something	'Unfortunately I have other priorities!'/'I don't quite agree with you on that one'.	Fisch (1998), Kauffeld (2007a), Gottman (1979)
	Content-related suggestion	Someone makes a content wise proposition that helps solving a problem	'We should take a look at the casebooks on this matter'.	Fisch (1998), Kauffeld (2007a), Gottman (1979)
Suggesting solution	A person provides an answer to the current problem		'Why don't we try it like this...'	Fisch (1998)
Additional categories				–
	Interrupting	A person stops someone else in mid-sentence	Person A: 'I assure that...' Person B: 'You can say what you want, we still should do...'	Kauffeld, (2007a), Kolbe and Boos (2009)
	One-word focusing statement	Someone makes a declaration that consists of only one word	'Absolutely!'/'Done!'	Data-based

developed inductively as well as based on the exploratory study (Kolbe and Boos 2009).

Since MICRO-CO is designed for the analysis of decision-making discussions, which are usually of a verbal character, it focuses on verbal communication used as coordination mechanisms. It does not include non-verbal coordination behaviour (e.g. proving task-relevant action without requests, such as holding up the correct surgical instrument after the attending surgeon has announced a change in procedure), as is the case in other coordination taxonomies that have been designed for analysing group coordination in high-risk, time-pressed work environments (e.g. Grote et al. 2003; Kolbe et al. 2009b; Manser et al. 2009).

11.3.3 Coding Procedure

The analysis of group decision processes requires the definition of the sampling rule (which subjects are to be observed and when) and the recording rule (how behaviour is recorded). Regarding the sampling rule, the most satisfactory approach to studying groups using means of observation is the so-called focal sampling method (Martin and Bateson 1993). Thereby, the whole group is observed for a specified period of time (e.g. duration of group discussion). In the case of MICRO-CO, all occurring behaviour is coded by applying the above MICRO-CO categories and by indicating who is communicating to whom. The recording rule indicates the way of coding, typically either continuous sampling (all occurrences are coded) or time sampling (behaviour is sampled periodically, e.g. every 10 s) (Martin and Bateson 1993). Despite the fact that periodic time sampling is usually considered more reliable for reasons explained ahead, we recommend recording the coordination behaviour continuously, which allows for assessing the 'true' frequencies and durations of events (Martin and Bateson 1993). The literature on observation sampling contends that in order to analyse the dynamic coordination process and to determine whether a certain coordination act is followed by another certain act as well as how long each act lasts, continuous coding is necessary, as it facilitates appropriate data analysis methods – for example, lag sequential analysis (Bakeman 2000; Bakeman and Gottman 1986). However, continuous coding challenges the proper definition of coding units, especially when defining the amount of communication behaviour that is coded into one category vs. another (McGrath and Altermatt 2002). We therefore recommend a technique for the systematic definition of coding units using ten segmentation rules[1] based on grammar (SYNSEG; Kolbe et al. 2007). This technique can be used for preparing transcribed or merely videotaped group decision-making discussions that can subsequently be coded with the subcategories of MICRO-CO.

[1]A description of the ten segmentation rules can be requested from the first author.

11.3.4 Reliability of MICRO-CO

In an ongoing study, we are investigating the impact of explicit in-process group coordination mechanisms on group decision quality. Within this study we tested MICRO-CO for inter-rater reliability. Two trained coders independently coded a group decision-making discussion of 25 min' duration. Faced with a personnel selection task, four group members had to choose one of four candidates. Coding units were defined using the above-mentioned grammar-based technique suggested by Kolbe et al. (2007), which resulted in 585 units. Analysis of Cohen's kappa to assess inter-rater agreement showed a mean value of $\kappa = 0.89$. The MICRO-CO categories 'suggesting solution', 'deciding', and 'interrupting' were especially reliable (each $\kappa = 0.99$), whereas the categories 'ask sb. to do sth'. ($\kappa = 0.66$) and 'suggesting procedure' ($\kappa = 0.79$) were the least reliable. Table 11.2 shows the mean kappa values for the six medium-level categories ranging between 'substantial' and 'almost perfect' reliability (Landis and Koch 1977, p 165).

11.3.5 First Experience for MICRO-CO Category Occurrence

In exemplifying the usage of MICRO-CO, we will first show its sensitivity in assessing the coordination character of statements made during group discussions. We will then refer to the validity of the three-level organisation of the taxonomy (main level, medium level, category level) and explain how these features help indicate the quality of the decision and also the usefulness of explicit coordination.

Applying the German version of MICRO-CO to group decision-making discussions showed the occurrence of a considerable proportion of explicit in-process coordination. A sample of 32 group discussions (duration 11–45 min, MD = 23 min, SD = 7.6 min) of experimental four-person groups was segmented as suggested by Kolbe et al. (2007), resulting in 22,920 units. They were coded using a slightly simplified version of MICRO-CO, which differs from Fig. 11.1 in only minor aspects (the two addressing categories were combined; only three types of instructions were differentiated; 'goal setting' and 'goal indicating' were combined; and five instead of seven types of questions were discriminated).

Table 11.2 Cohen's kappa for MICRO-CO medium-level categories (two coders, 585 units)

Medium-level category	Cohen's kappa values
Instructions	0.73
Structuring	0.91
Questions	0.95
Content-related statements	0.89
Additional categories	0.97
Addressing	*Did not occur*

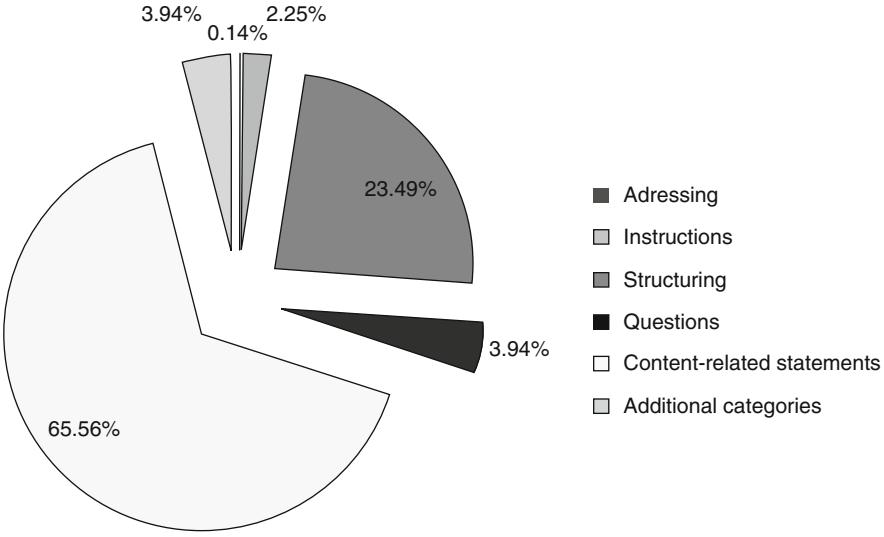

Fig. 11.2 Occurrence of medium-level categories of MICRO-CO (32 four-person groups, 22,920 units)

Figure 11.2 depicts the occurrence of medium-level categories: About one third of the discussions served coordination purposes, mainly by structuring statements. These results indicate that MICRO-CO serves its purpose in being very sensitive to the explicit coordination character of statements made during group decision discussion.

The 32 groups analysed in the above-mentioned study are part of an ongoing experimental series on the effectiveness of coordination mechanisms. Assuming that repeating already-mentioned information facilitates group cognition during decision making and thus contributes to the quality of group decision, Kolbe (2007) instructed one of the four members per group to facilitate the group discussion, instructing half of these lay facilitators to specifically 'repeat' important information others had mentioned. 'Repeating' is a subcategory of the 'structuring' category on the medium level which belongs to the 'coordination' super-ordinate category of MICRO-CO (see Fig. 11.1). According to the manipulation, groups varied in the amount of 'repeating' information from 6–27% of their units, leading to a range of 15–37% 'structuring' behaviour, and 23–46% 'coordinating' behaviour, respectively. The group decision served as the main dependent measure: A correct decision represented a solved hidden profile. Forty percent of the groups were correct. Figure 11.3 illustrates the logistic regression of correct decisions on the amount of coordinating behaviour on the three levels of MICRO-CO (coordinating, structuring, repeating). As Fig. 11.3 shows, prediction of decisions is possible on each of the three levels of the taxonomy (Nagelkerke's $R^2 = 0.41$ for 'repeating', $R^2 = 0.23$ for 'structuring', and $R^2 = 0.21$ for 'coordinating' on the highest level). This means that decision-making quality in this study can be

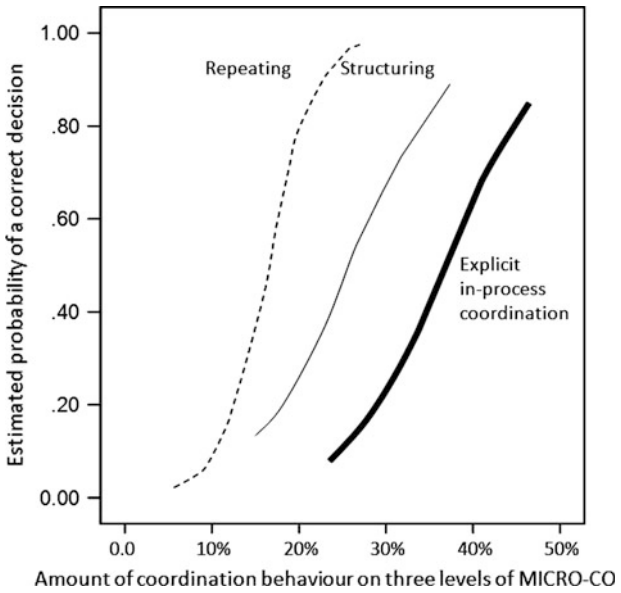

Fig. 11.3 Logistic regression of the correct decision on coordinating behaviour on the three levels of MICRO-CO (32 groups)

attributed to a large degree to sound explicit coordination, to structuring, and especially to repeating information. Thus, using MICRO-CO allowed for these multi-layer findings on the usefulness of explicitness during group decision making to be obtained.

11.4 Discussion

The MICRO-CO taxonomy presented here allows for micro-analytically analysing coordination mechanisms in human decision-making groups. Developed on the basis of both coordination theory (see Chap. 2) and empirical data from group decision-making discussions, it provides a reliable and manageable set of coding categories applicable to group decision-making discussions. Compared to existing taxonomies of group processes, MICRO-CO permits a detailed analysis of the coordination character of statements made during group discussion by precisely distinguishing among a variety of explicit mechanisms in a hierarchical framework. MICRO-CO is designed to permit group researchers to assess the occurrence and duration of both explicit in-process coordination mechanisms as well as content-oriented utterances. The resulting codes can subsequently be integrated in lag sequential analysis (Bakeman and Gottman 1986), revealing insights into the proximate functions of the explicit mechanisms for the ongoing group discussion.

This analysis could, for example, investigate whether content-oriented statements occur only in response to explicit 'request' categories (see Sect. 11.1.2.3). An unsolicited occurrence of task-relevant content-oriented statements could be regarded as an indicator of implicit in-process coordination (anticipation ratio; see Serfaty et al. 1993; Toups and Kerne 2007). Due to these built-in tools enabling the micro-analysis of content occurrence, duration, source, and especially the ability to assess the degree of explicit vs. implicit coordination MICRO-CO is also useful for comparing effective and ineffective decision-making groups with regard to their coordination behaviour. One example was given in Fig. 11.3, where the solution of a hidden profile was regressed to coordination on the three hierarchical levels of MICRO-CO. With regard to the distal effects of coordination behaviour, we consider this micro-process analysis an important contribution to increasing our understanding of the characteristics of effective human group decision making. Furthermore, MICRO-CO can be used to analyse the coordination behaviour of group facilitators or leaders and contribute to the training of the effectiveness of their behaviour.

Further research should address the issue of validity of MICRO-CO. Dickinson and McIntyre (1997) have pointed out that construct validity of the observation method requires the ability to discriminate between groups. An important advantage of micro-coding systems such as MICRO-CO is that they allow for identifying task-relevant and rather fine-grained, subconsciously occurring behaviour – group behaviour not detectable on a more aggregated level. On the other hand, in micro-coding systems, category membership is frequently based on the meaning or structure of single-member statements, resulting in a lack of synthesis of individual utterances into interaction or group process indices. In this sense, Marks and colleagues (Marks et al. 2001, p. 364) have discussed that 'detecting processes often requires more macro observation of the verbal exchanges and behaviours that take place during a particular episode'. We suggest that lag sequential analysis might serve as a tool for analysing proximate functions of individual coordination behaviour, empirically clustering micro-level findings on macro-level patterns. As such, lag sequential analysis can be used to investigate the antecedents and functions of single coordination behaviours within and between group members (e.g. Grote et al. 2010; Kolbe et al. 2009a). The resulting coordination patterns can be utilised as dynamic group-level indices and can be compared between different groups. Lag sequential analysis can also be applied to classify behavioural codes by means of their functional similarity (Jacobs and Krahn 1987). The said application addresses the issue of appropriate aggregation, which is particularly important when we are interested in the distal consequences of coordination behaviour such as its long-term effectiveness (Dickinson and McIntyre 1997). Further observational research on group processes such as coordination might profit enormously from an integrative comparison of the methods applied in the domain of observing human and non-human primate groups. In particular, important methodical issues such as sampling, aggregating codes, editing, and analysing observational group process data are worth comparing vis-à-vis their construct validity. There may not be the silver bullet, but some standards would be beneficial.

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