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Editors

Advances in Group Decision and Negotiation 4

Handbook of Group Decision and Negotiation

 Springer

Advances in Group Decision and Negotiation

Volume 4

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Handbook of Group Decision and Negotiation

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ISBN 978-90-481-9096-6 e-ISBN 978-90-481-9097-3
DOI 10.1007/978-90-481-9097-3
Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2010929844

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Printed on acid-free paper

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Analysis of Negotiation Processes

Sabine T. Koeszegi and Rudolf Vetschera

All social phenomena unfold and change over time, and one of the best ways to understand them is to discover how they are born, develop, and terminate [...].

Holmes and Poole (1991, p. 286)

Introduction

Negotiation is a highly interdependent process, in which decisions of the negotiating parties are interlinked through a variety of interactions between parties. The role of decisions and interactions is reflected in the structure of negotiation support systems (See the chapter by Schoop, this volume), where one distinguishes between decision and communication components, and in negotiation protocols (See the chapter by Kersten and Lai, this volume), which structure negotiations at the levels of decisions, language and process. The particular complexity of negotiations results not only from the fact that decisions of negotiators are interlinked via communication processes, but also from the fact that these communication processes involve many different levels, ranging from factual information about the issues being negotiated to explicitly or implicitly relationship-oriented communication (See the chapter by Ackerman and Eden, this volume), and emotions (See the chapter by Martinovski, this volume).

Although these streams of research focus on different aspects of the negotiation process, and consequently define and model negotiations in different ways, the importance of a process perspective is emphasized by many researchers (Weingart and

Olekalns, 2004). In a broad sense, the negotiation process can be defined as "(...) the interaction that occurs between the parties before the outcome (...)" (Thompson, 1990, p. 516). Furthermore, the decision processes of negotiators are interlinked by communication, thus communication can be considered to lie "at the heart" of the negotiation process (Lewicki and Litterer, 1985). In order to analyze communication comprehensively, researchers have to apply qualitative as well as quantitative methods. In this chapter, we give an overview of different methods to analyze negotiation processes by looking at the information exchange that takes place during a negotiation. Given the complexity and multitude of these communication processes, each of these methods highlights different angles of the process and delivers valuable insights into negotiations.

In general researchers can pursue two "opposite" strategies when working with qualitative material (in qualitative research also called "texts", see e.g. Flick (2009)): One strategy is to reduce the original text by paraphrasing, summarizing, or categorizing it. This *Coding* of the material has the aim of categorization and/or theory development. Furthermore, coded data can also be subjected to subsequent quantitative analysis methods. The other strategy is to reveal and uncover meanings of the text. This *Analysis* aims at reconstructing the structure of the text and usually leads to an augmentation of the material. Depending on the research approach – inductive or deductive – both strategies are applied in different ways. In a deductive research approach, researchers usually apply these

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strategies rather sequential and perform analysis only after coding is completed. When following an inductive approach, however, researchers combine analysis and coding in an iterative process (Flick, 2009, p. 306).

In the following discussion of methods, we mainly compare different *analysis strategies* and do not focus on different coding strategies. Instead, we provide here only a brief description of one approach, the *qualitative content analysis method*, since this coding strategy has received most attention in negotiation research and has been widely applied. Furthermore, several methodical papers have been published in this area (e.g. Druckman and Hopmann, 2002; Harris, 1996; Srnka and Koeszegi, 2007; Weingart et al., 2004). During several stages of qualitative content analysis nominal data for further analysis is created: In the *Unitization* stage, researchers decide on the unit of analysis and divide the material into coding units which could be words, sentences, text chunks, turns, or interacts. In the *Categorization* stage a scheme of categories relevant to the research problem is developed by grouping the qualitative material in theoretically insightful ways (Mayring, 2002). Here, researchers have to decide whether extant categories are used or new ones are developed. The criterion of reliability would induce analysts to promote "standard categories" (derived from theory) that can be used repeatedly, whereas the criterion of validity rather suggests the (inductive) development of "original systems" that capture the essence of the phenomenon under study (Druckman and Hopmann, 2002). In the final *Coding* stage, category codes are assigned to the text units. Category definitions and key anchors established throughout the process of categorization serve as rules that ensure consistent and thus reliable coding. In order to guarantee reliability of results, several quality checks and the involvement of multiple coders are necessary (see e.g. Brennan and Prediger, 1981; Folger et al., 1984; Holsti, 1969).

This chapter introduces analysis methods and some interesting findings obtained with them. Since all methods we present analyze the communication process between negotiators, we classify them according to their perspective of the information exchanged. We use two dimensions for this classification:

1. The first dimension classifies methods according to their granularity, i.e. the elements of the communication process which form the elementary units of analysis. We distinguish between three

different degrees of granularity: micro-, meso-, and macro-level of analysis. A micro-level analysis concentrates on single utterances or interacts or uses single utterances for further analysis. This is the smallest information object considered here, we do not consider the internal composition of utterances (e.g. pauses or single sounds), which might be important e.g. for the analysis of emotions (Martinovski, "Emotion in Negotiation", in this volume). A meso-level analysis is based on interaction patterns including several utterances or interacts (e.g. episodes or phases), and a macro-level analysis considers the whole negotiation process. While several authors (e.g. Druckman, 2003) consider the context of the negotiation as a still higher level, and consequently use the term "Macro" to cover this broader context, we limit our survey to approaches that stay within a given negotiation, and define our terminology accordingly. The level of granularity has implications for other features of the methods. In particular, it affects the number of cases which can be analyzed, since a detailed analysis can only be performed on a small number of negotiations. The number of cases in turn affects the interpretation and possible generalization of results.

2. The second dimension distinguishes between methods which analyze the entire communication between negotiators and methods which focus only on parts of the information exchange. Communication in negotiation covers a wide spectrum of different types of information, ranging from non-verbal cues to numerical values contained in offers. We classify methods that aim at analyzing this entire spectrum of communication as "inclusive methods" and methods which deal only with specific parts of the communication process as "selective methods". Although in general, the focus of such a method could be on any part of the communication process, the selective methods we consider here typically concentrate on substantive aspects of negotiations (e.g. the specific values offered or demanded in each issue) (Weingart and Olekalns, 2004). While these two categories can roughly be related to the analysis of qualitative vs. quantitative data, these two distinctions do not necessarily overlap. Several methods which we label as inclusive start from qualitative information, but transform it in a way which makes quantitative, statistical analysis possible. This dimension also influences the number of cases which can be

analyzed, since inclusive methods require a considerable effort in coding and preparing data for further analysis.

Figure 1 gives an overview of the methods we discuss in this chapter according to our two dimensions. In the subsequent sections, we will present seven distinct methods in detail. While we describe these methods individually as different approaches, there will obviously be large overlaps in their practical application. In many cases, it will not even be possible to state whether a particular study applies one method or the other. We consider the integration of methods as a necessity when dealing with such a complex phenomenon like negotiation. Nevertheless, by highlighting characteristic features of each of those seven methods, we hope to guide researchers to additional perspectives and approaches that might be useful for getting a more thorough understanding of their topic. The seven methods covered in this chapter are:

1. *Discourse analysis* and *ethnographic approaches* are focusing on macro-analytic aspects of negotiations in order to explain sequences and episodes of interaction. Discourse analysis provides an in-depth analysis of meaning and interpretation of communication arising in a negotiation process. It usually looks at the whole negotiation in its context and is therefore mainly applied to single cases.
2. *Frequency analysis* considers the frequency of occurrence of different types of communication acts during a negotiation. It is a comprehensive approach, which takes into account all types of

communication acts. Since it is based on individual communication acts, we consider it as a micro-level analysis. It has been applied widely for both face-to-face negotiations and e-negotiations and has already delivered a substantial body of knowledge about occurrence and impact of strategies in negotiation. However, this method does not consider the precise time structure at which communication acts occur during a negotiation and thus is not able to provide insights into action-reaction patterns.

3. To identify such patterns, *interaction analysis* (sequence analysis) has been applied in negotiation research. It measures temporal dependency in negotiation data. With its help, researchers can identify the influence of one negotiator's behavior on the opponent's behavior and predict negotiation outcomes depending on strategy use. While interaction analysis captures patterns of action and reaction within a negotiating dyad, it ignores the larger structure of the process, i.e. at which point in time during a negotiation these patterns occur.
4. *Phase analysis* is concerned with the temporal structure of the entire negotiation process and changes in the communication flow as the negotiation proceeds toward its outcome. Researchers applying this method identify sequences of events and explain how and why negotiation behavior changes over time as parties interact. Phase analysis has been applied widely and researchers came up with several descriptive as well as prescriptive phase models.
5. Similar to interaction analysis, *offer process analysis* is also interested in the dynamic and

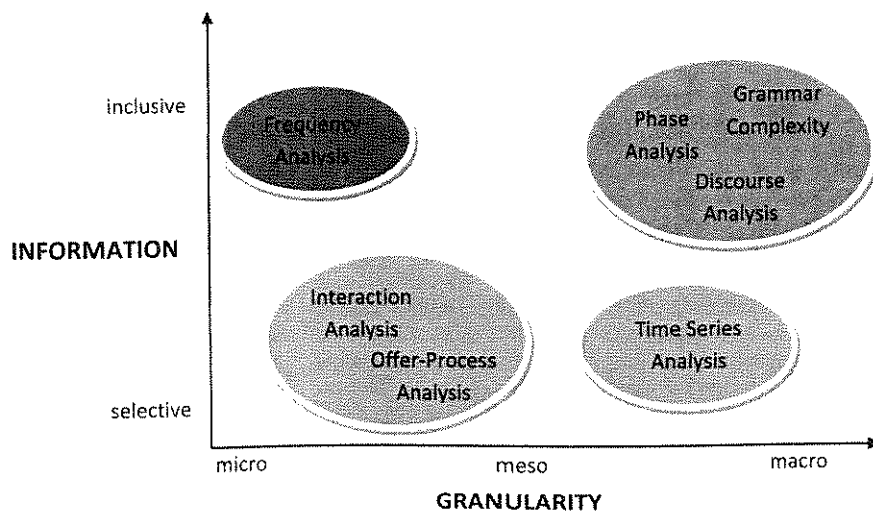


Fig. 1 Classification of analysis strategies

interactive nature of the negotiation process. It focuses, however, on the exchange of offers and counter-offers during a negotiation and thus considers only part of the entire information flow. Because it is mostly based on quantitative data, which can be obtained more easily during a negotiation, it is possible to consider a larger number of negotiations than in interaction analysis.

6. *Time series analysis* is appropriate for discovering longitudinal patterns like trends or cycles in continuous variables, and also the temporal structure of relationships between quantitative variables. It requires quantitative data, which can be related to the substantive level of negotiation processes, or can be obtained from the transformation of qualitative information.
7. Finally, *information theory and grammar complexity* are quantitative methods which examine negotiation interaction using tools from information theory and the theory of dynamic systems. They deliver meta-characteristics providing a quantification of negotiation processes. These tools have only recently been applied to negotiations (Griessmair et al., 2008).

Discourse Analysis and Ethnographic Studies

Discourse analysis¹ is a qualitative research method aimed at the in-depth analysis of meaning and interpretation of communication arising in a negotiation process: "... *this mucking in the thick of things is the key to discovering subtle nuances of not only*

¹ In the post-modernist and (post-) structuralist research paradigm, discourse is understood as an ideological practice. "If language does more than reflect meaning, if it actually constructs this meaning, then discourse becomes a central aspect of investigation in understanding the reproduction and reconstruction of ideology" MacDonald (2003, p. 154). In this context, discourse analysis is a tool through which the construction, contestation and negotiation of social value, authority, power, dominance, and knowledge can be revealed. In this chapter we focus on research that uses discourse analysis in the traditional way, i.e. as a means of linguistic analysis of communication. Nevertheless, we also briefly touch post-modern ideas when discussing narrative analysis, a form of rhetoric analysis, in this section.

what negotiators say but also what they do not say" (Putnam, 2005, p. 17). In contrast to other types of linguistic analyses, such as semantics (the study of meaning and lexical nature of words), phonology (the study of sounds), morphology (the study of the structure and content of word forms), and syntax (the study of the order of words in sentences), discourse analysis considers larger chunks of language beyond single sentences. It investigates the whole negotiation in its context and is more inductive than theory-driven. In many instances coding and analysis strategies are applied simultaneously.

Putnam (2004, 2005) distinguishes between three different types of discourse analysis: (1) conversation analysis, (2) pragmatics, and (3) rhetorical analysis.

Conversation analysis uses both verbal and paraverbal language cues to gain detailed insights into *micro-processes of interaction*, i.e. patterns, sequences, and structures of communication. The *language structure* – as opposed to the *language content* defined by speech acts – consists of conversational management devices such as overlaps, interruptions, pauses, prosodics (intonation, stress, pitch, volume), or repairs (how communicators deal with problems in encoding and decoding messages), which are also referred to as the "turn system" (Neu, 1988). Neu (1988) argues that conversational analysis reveals *how* messages are conveyed (i.e. the particular way of speaking) and therefore provides essential information in the study of bargaining behavior which is inaccessible with content analysis alone. By conducting a factor analysis using both, content and conversation management categories, she shows how conversation structure analysis can help to interpret communication in negotiations. In particular, conversation analysis demonstrates the importance of conversational management devices in revealing e.g. status, dominance, and roles of speakers (Condon and Cech, 2001; Neu 1988). For example, relative turn size reflects success or dominance of speakers, interruptions and overlaps mark status in interactions, pauses carry messages about the personality of the speaker (e.g. speakers with frequent pauses are judged as less extroverted), or frequent self-repairs in a negotiation reveal the speaker as indefinite and uncertain. Furthermore, Condon and colleagues (Condon and Cech, 1996, 2001; Condon et al., 1999) apply turn profile analysis to decision making processes in different communication environments, e.g. face-to-face, e-mail, or chat systems. They show that

individuals apply different strategies for organizing their decision-making depending on turn sizes, which are contingent on the communication environment. This identification of effective strategies of conversation management in different media supports designers of negotiation and communication systems to develop effective systems.

The second type of discourse analysis, pragmatics, analyzes the *language content*, i.e. the meanings of words in the interaction context. It therefore examines the way *how language is used*. The study of speech acts in negotiations such as threats, promises, and commitment statements uncovers how language accomplishes communication goals, e.g. how to build up a relationship in negotiation or how to use tactics that serve the end of individual gains, etc. (Putnam, 2004). Simons (1993) relates, for instance, the micro patterns of the use of noun phrases (i.e. words or groups of words used as nouns, which could either be person-focused, like you, I, we, etc., or thing-focused, like money, price, etc.) to identify integrative strategies and to predict outcome. Similarly, Sokolova and Szpakowicz (2007) performed an analysis of electronic negotiations using statistical natural language processing and machine learning techniques to identify characteristic phrases as predictors for success or failure of negotiations with an accuracy of 70%. Lincke (2003) uses pronoun and speech act analysis to identify cultural differences of negotiators in different communication environments.

Finally, rhetorical discourse analysis focuses the analysis of negotiations on *broad-based language patterns* and draws on ethno-methodology (Putnam, 2004). It is aimed at the study of persuasion, argumentation, and symbolic meaning (Putnam, 2005). Here, negotiations are understood as narratives or dramaturgical texts and researchers try to untangle how meaning evolves and is co-developed during negotiation processes. According to Putnam (2005), rhetoric analysis is performed through studies of argumentation (the analysis of ways how bargainers legitimate claims and support individual positions), as literary analysis (studying the ways how words and phrases become shorthand expressions for past discussions and shared experiences), or as narrative analysis (the analysis of how talk constructs complete stories with plot lines, motives, values etc.). Especially in this form of discourse analysis ethnographic knowledge of the broader context of the negotiation is essential.

Researchers usually interpret patterns of language use within the context of a full negotiation and its participants. Keough (1992) discusses the theoretical background of argumentation analysis and Martinovski and colleagues (Martinovski and Mao, 2009; Martinovski et al., 2007) deliver an example. They study the linguistic realization of empathy and show how empathy and rejection of empathy contribute to the changes of goals and strategies during negotiation. An example for literary analysis is provided, for instance by Putnam (2004), who analyzes the role of metonymy (the figure of speech in which a term denoting one thing is used to refer to a related thing, e.g. "crown" for "king", "white house" for "president of the United States") and synecdoche (the figure of speech in which the whole stands for its constituent parts or vice versa, e.g. "culture" for values, rituals, and myths) used in discourse. This analysis allows uncovering how negotiators enact tacit norms, how they use bargaining formulas, and how they relate to each other. By comparing negotiation processes between teachers and administration in two public school districts, Putnam (2004) shows different ways how meanings and interpretation are produced through social interaction.

Finally, an example for a narrative analysis of negotiations is provided by Johnston (2005). Narrative analysis is intended to understand individual interpretations of negotiation processes and underlying conflicts. In contrast to other methods described here, the interpretation of a narrative, i.e. a story, is only valid within this specific narrative and reliability usually lies only within the specialized knowledge of the one person telling the story (Johnston, 2005).

The ethnographic approach as suggested for instance by Friedman (2006) and Seligmann (2005), is closely related to the rhetoric approach of discourse analysis. Ethnographic research also looks at behavior in the entire negotiation context, but as a form of field research it usually targets real negotiations lasting over natural periods of time. Friedman (2006), for instance, was studying labor negotiations for 5 years by observing negotiation sessions, attending caucuses of both sides, and debriefing and interviewing bargainers and participants. This form of research generates unique insights into negotiations that cannot be gained through any other method but, at the same time, it is an extremely labor-intensive research method requiring extensive experience and rigor from the researcher.

In general, the advantages of discourse analysis (and ethnographic research) are summarized by Putnam (2005) in four arguments: (1) Discourse analysis allows to identify patterns, rules, and practices that evolve over time during negotiations within the specific context. (2) Because it refers back to the larger context, in which the negotiation takes place, discourse analysis makes it possible to link political, legal, and organizational macro processes to micro behaviors in the negotiation. (3) Discourse analysis requires the employment of reflexivity. This helps to reveal relationship and identity aspects beyond the instrumental level of negotiations. (4) As an inductive research method, discourse analysis leads to the discovery of new concepts enriching negotiation theory.

One of the major drawbacks of discourse analysis, as well as ethnographic research, lies in its implementation. It requires texts (transcripts of negotiations, documents, interviews, field notes, etc.) which need to be selected and linked to each other as well as to the larger context. As Putnam (2005, p. 27) states: "Researchers have to be willing to muck around in the data". This is not only extremely labor intensive but also prone to a sprawling and unsystematic following of traces. As with all other qualitative research methods, it is therefore necessary to guarantee scientific rigor through defining a research problem of importance – from within the setting or from negotiation literature – and by applying instruments helping to track analysis such as charts and spreadsheets (Putnam, 2005). What is more, to keep the research focused on language analysis it is necessary to concentrate "on the way that patterns of discourse construct, alter, and produce a negotiation. . ." so that one does not get lost in a "... 'play by play' description of the event" (Putnam, 2005, p. 28) like in case studies.

Frequency Analysis

Much of the research in negotiation processes reflects a frequency perspective measuring *distributional dependency* in the data (Weingart and Olekalns, 2004). Methods of frequency analysis allow answering questions relating to the frequency of occurrence of communication acts during a negotiation. Studies using frequency analysis examine the effect of exogenous

variables (e.g. media, support systems, gender, etc.) on the occurrence and frequency of specific behavior of negotiators (e.g. their strategy and tactics), the effect of strategies and tactics on outcomes, or the interactive relationships between these variables. We therefore categorize this method as a micro-level analysis.

Frequency analysis requires coded and categorized data, most often derived from qualitative content analysis processes. It is useful to start categorization processes with extant coding schemes. The negotiation literature offers a variety of different schemes. In particular, Donohue et al. (1984), and Putnam and Jones (1982a, b) provide an excellent review and critique of two important schemes, the Conference Process Analysis (CPA) scheme and the Bargaining Process Analysis II (BPA II) scheme. By applying exploratory factor analysis, Putnam and Jones (1982a) have organized the communication categories of the BPA II scheme into three strategies, termed "offensive", "defensive" and "integrative" strategy. These strategies represent a series of bargaining tactics (communicative acts) aimed at accomplishing long-term objectives. For electronic negotiations, the BPA II scheme was adapted by Koeszegi et al. (2006). They also apply factor analysis to the adapted scheme and identify similar strategies (distributive, integrative, and relationship building strategies). A conceptually different scheme was developed by Weingart and colleagues (Olekalns et al., 2003; Weingart et al., 2004). Instead of using factor analysis to identify strategies, they used multidimensional scaling (MDS) and suggest a category scheme classifying negotiation behavior along two dimensions: strategic function (behavior vs. action) and strategic orientation (individualistic vs. collectivistic). The resulting four clusters comprise the following "strategies": distributive information vs. integrative information and claim value vs. create value.

In further statistical analyses (MANOVA models, etc.), these strategies are related to exogenous variables or to outcomes. Frequency analysis has already delivered a substantial body of knowledge about strategies in negotiation. For instance, integrative tactics and strategies are associated with reaching high joint gains, while a more frequent use of distributive tactics and strategies may increase the likelihood for impasses and stalemates. A detailed report of findings is beyond the scope of this chapter, for an overview consult e.g. Womack (1990) or Weingart and Olekalns (2004).

Interaction Analysis

Extending frequency analysis, interaction analysis enables researchers to capture patterns of action and reaction within a negotiating dyad. With its help, researchers can answer questions on how tactics and strategies used by negotiators during the course of a negotiation depend on one another and questions like: "Given the specific history of a negotiation process until a particular point of time: what is the probability that a particular tactic is used by a negotiation party?" can be answered with interaction analysis.

While frequency analysis assesses distributional dependencies in the data, interaction analysis deals with *temporal dependency* (Folger et al., 1984). If, for instance, A, B, and C represent categories for communication acts coded along a time-line, then the sequence A-B-C-A-B-C-A-B-C manifests a strong temporal dependency. Here we see, that B always follows A, C always follows B, and A always follows C (except for the beginning and the end of the sequence). Thus, a temporal dependency allows the prediction of some subsequent event beyond chance, given that the occurrence of some antecedent event is known. Because this method considers interacts (adjacent communication acts, i.e. $\Delta t = 1$), pairs with greater time lags ($\Delta t > 1$) or even more than two consecutive communicative acts (like in second or higher order Markov chain models), we categorize its granularity as micro- to meso-level analysis. Therefore, the method is applicable to a medium or larger number of cases. There are several sequence analysis methods² to analyze the temporal ordering of coded acts. However, negotiation scholars have applied especially (1) Markov chain analysis and (2) lag sequential analysis, particularly for analyzing the strategic use and the effect of individual tactics. For a systematic comparison of the two methods please refer to Olson et al. (1994).

² Sequence analysis methods are applied to any type of sequences, e.g. repeated decision making events of an individual. If however the unit of analysis is a sequence of interaction (e.g., communication between two or more individuals), we also use the term interaction analysis.

Markov chain models use a log-linear modeling technique to analyze multi-way contingency-tables assessing conditional probabilities that a specific event has certain characteristics depending on the characteristics of a fixed number of preceding events. In several studies, Weingart, Olekalns, Smith and colleagues have applied Markov chain models to coded negotiation data, (e.g. Olekalns and Smith, 2000; Weingart et al., 1999, 2007). A detailed description of Markov chain analysis is provided by Smith et al. (2006, p. 258) and Olson et al. (1994). It includes, in principle, the following four steps:

- (1) *Determination of the strategies or tactics covered by the analysis:* Similar to frequency analysis, communicative acts need to be coded into a category scheme. For instance, a very simple category scheme is the classification of communicative acts either as distributive or as integrative behavior. More detailed category schemes comprise a higher number of strategies or tactics, which increase the complexity of Markov chain models.
- (2) *Construction of contingency tables (the transition matrix) representing the dependencies among strategies in sequences of a particular length:* As mentioned before, Markov chain models assess conditional probabilities that a specific event takes a given value given a fixed number of preceding event values. The number of previous values being considered determines the order of the chain. For instance, in a first-order Markov chain it is assumed that the communicative act of a negotiation party at a given point of time is only dependent on the one preceding communicative act of the other party. A second-order Markov chain model would assume that the behavior of one party is dependent on the two preceding acts, one coming from the other party *and*, as a second preceding act, the negotiator's own previous tactic, and so forth. Weingart et al. (1999) and Smith et al. (2006) note that in their studies of empirically observed negotiation processes second-order chains were sufficient.
- (3) *Log-linear analysis of Markov chain models determining the length of strategy sequences that best captures the communication:* By applying log-linear modeling techniques, the order of the chain is assessed by determining the highest order

interaction needed to describe the dependencies in the sequence of the coded communicative acts. For instance, to conclude that a given negotiation data set is at most second-order, all interactions of a third-order chain are tested for significance and must be insignificant. In this step, it is also possible to compare Markov chain models derived from different subpopulations, i.e. to test the effect of independent variables (like experimental treatments) on sequences of communicative acts during the course of negotiations. Log-linear modeling techniques also allow to define subpopulations retrospectively, e.g. according to the outcomes reached.

- (4) *Analysis of residuals assessing strategy sequences contributing to the overall model fit.* Finally, through the comparison of (nested) models and the interpretation of their standardized residuals, it is possible to characterize the identified effects qualitatively.

With the help of Markov chain models, Weingart et al. (1999) for instance show that negotiators respond in-kind to both distributive and integrative tactical behavior. However, negotiators with tactical knowledge are more likely to reciprocate integrative behavior and to engage in longer integrative sequences than negotiators without tactical knowledge. In another study, Weingart et al. (2007) analyze the influence of social motives of negotiators (cooperative vs. individualistic) on the choice of strategy and strategy sequences. They show that cooperators do not only respond more systematically to the other parties' behavior than individualists but they also adjust their use of integrative and distributive strategies depending on the social motives of their counterparts.

The second method frequently applied in interaction analysis is lag sequential analysis, a technique determining whether particular events follow other events at frequencies beyond chance (Olson et al., 1994). Lag sequential analysis not only permits the investigation of immediately adjacent communication acts, but can also be applied to communication acts at arbitrary lags. For negotiation process analysis this means that using lag sequential analysis one can calculate whether a specific tactic is more likely than chance to follow another tactic after some number of intervening communicative acts. Furthermore, it is also possible to look at patterns of relations among more than two states

(Olson et al., 1994): An indirect way of confirming the hypothesis that A B C is a frequently occurring pattern, is to find a significantly high frequency for AB and BC (lag 1) and AC (lag 2).

For performing lag sequential analysis one has to define a *criterion category*. Then, for a lag 1 analysis, for each occurrence of that criterion, the number of times a particular behavior immediately follows this criterion is counted, for lag 2, the second communication act following the criterion, at lag 3, the third communication act after the criterion is analyzed until max lag, the largest sequential step. Statistical significance can be tested by the *z score* statistic proposed by Allison and Liker (1982).

Several negotiation studies have applied lag sequential analysis. Putnam and Jones (1982a), for instance, show with experimental research that dyads who did not reach an agreement exhibit a tightly structured, reciprocal attack-attack or defend-defend pattern. This pattern was not found in successful dyads. Donohue has developed a negotiation interact system classifying communicative acts into cuing and responding tactics (Donohue, 1981a, b; Donohue et al., 1984). By applying lag sequential analysis he also shows, that the outcome of a negotiation can be predicted by studying the proportions of use of different tactics (Donohue, 1981a).

Phase Analysis

Phase analysis is another method to analyze time dependent structures in negotiation processes by describing the communication flow toward the outcome. While interaction analysis captures patterns of action and reaction within a negotiating dyad but ignores *when* these patterns occur, phase analysis enables researchers to identify sequences of events across the entire process and explain how and why negotiation behavior changes over time as parties interact (Holmes, 1992).

Like frequency and interaction analysis, phase analysis is based on categorized communication acts, but it divides interaction processes into coherent periods. We therefore categorize the granularity of this method as meso-level analysis. It provides researchers with a "map" of social interaction explaining types and sequences of developmental paths, their structural properties such as cycles, repetitions or transition

points, and factors influencing or causing the development of interaction (Holmes and Poole, 1991).

According to Holmes (1992) two theoretical and methodological issues have to be resolved in phase analysis research. The first theoretical issue is: "What constitutes a phase?" and the related methodological question "How can we identify a phase?" The second theoretical issue is "What generates changes between phases?" and the associated methodological question "How can we identify phase transitions?" Phase research has come up with alternative answers to these questions which resulted in two types of phase models: stage models and episodic models. Stage models assume coherent periods of interaction dominated by particular communicative acts. These models assume that negotiations pass through certain distinct stages on the way to an outcome. Usually, one cannot clearly determine where stages end and subsequent stages begin but they rather overlap to some degree. Therefore, researchers often use fixed intervals with arbitrarily defined boundaries between phases. In contrast, episodic models are based on explicit boundaries between clearly identifiable interaction structures (i.e. episodes). In episodic models, transition points help to distinguish between periods with consistent sets of behaviors. As a consequence, stage models treat phases and their sequence as fixed whereas episodic models allow for flexible phases including variation, cycles, and return to previous behavior (Weingart et al., 2004).

Because the stage model approach is less complex and therefore needs less data, it is used more often (see e.g. Adair and Brett, 2005; Weingart and Olekalns, 2004). Such an approach is, however, problematic for two reasons (Holmes and Poole, 1991; Poole and Roth, 1989): it is impossible (1) to determine alternative or multiple sequence paths and (2) to discriminate between groups (dyads) which differ in lengths and numbers of phases. Holmes (1992) therefore discusses three tools to overcome these problems: flexible phase mapping, gamma analysis, and optimal matching analysis.³

All three tools are applied to coded interaction data. Flexible phase mapping is a procedure to establish

boundaries between phases based on shifts in functions of interaction through researcher-determined parsing rules. The result of this procedure is a phase map, i.e. a time line of negotiations indicating clear boundaries between phases. In order to generate sequence typologies (e.g. types of sequence paths), gamma analysis is an appropriate tool. This method uses Goodman-Kruskal Gamma to identify a phase structure and subsequently tests whether there are unitary or multiple sequence paths. Furthermore, it identifies between-group (dyad) differences in types and sequences of phases by calculating precedence and separation scores (see e.g. Olekalns et al., 2003). Finally, optimal matching analysis allows comparing detailed phase maps produced by flexible phase mapping. It is a method which rank-orders cases by their distance from a model sequence and was applied to negotiation processes by Holmes (1997). These tools have been developed originally for the analysis of small group decision processes and have been applied later to face-to-face negotiations. As an alternative tool specifically designed for phase analysis of negotiation data, Koeszegi et al. (2009) have developed a data-driven method for the endogenous identification of transition points in phase analysis. With their method, larger datasets can be analyzed and advantages of both, episodic and stage phase analyses, can be combined.

Negotiation literature offers a substantial variety of descriptive as well as prescriptive phase models for negotiation (for an overview see e.g. Holmes, 1992). The majority of these models includes two to four phases and is based on the idea of unitary sequence, i.e. one stage following the other determined by the inherent logic of conflict resolution through negotiation. A well-known phase model was developed by Adair and Brett (2005) in their analysis of the "negotiation dance" of negotiators coming from different cultural backgrounds. Their stage model divides the whole interaction process into four equally long phases. At the outset, negotiators have little information about preferences and needs of their negotiation partners. Since most negotiators have a fixed-pie bias, negotiators in this phase assume that the other party wants the opposite of what they want. Thus, at this early stage, negotiators try to position themselves and to establish power. Adair and Brett (2005) have labeled this stage "Relational Positioning". As negotiators move on, they try to clarify the issues of the negotiation problem. This second stage, "Identify the Problem", is characterized

³ A detailed application of these tools can be found in Poole and Roth (1989) as well as in Holmes and Poole (1991). Holmes (1997) and Olekalns et al. (2003) have already used these tools to analyze negotiation processes.

by exchange of information about issues, options and underlying interests and priorities of the parties. Once negotiators have built an understanding of these topics, they move on to the next stage and start to claim their share of the disputed value. Adair and Brett (2005) have labeled stage three "Generate Solutions", which is characterized by a shifting focus between competitive and distributive behavior to influence the outcome on one hand, and integrative information exchange to move toward an agreement on the other hand. Finally, at the end of the process, parties try to reduce the complexity of the problem by eliminating alternatives. Since most of the information and persuasive arguments are already on the table, they do so by exchanging offers and counter-offers. Adair and Brett (2005) labeled this final stage "Reach Agreement". They find empirical evidence that their normative phase model is helpful for managing the evolution and strategic focus during negotiations.

Offer Process Analysis

In contrast to the other methods discussed in this chapter, offer process analysis is exclusively focused on the substantive level of negotiations, which is usually presented in the form of quantitative information. Following Tutzauer (1992), offer process analysis argues that offers are the most important part of communication during a negotiation, because they shape the outcome of negotiations in terms of the actual issues being negotiated. Offer process analysis therefore views a negotiation as a (more or less structured) exchange of offers.

The focus on offers formulated in terms of issue values adds another dimension to the analysis of communication processes: With respect to offers, the distinction between single- and multi-issue negotiations becomes important, since the latter type provides a far greater range of possibilities to construct offers. However, many approaches to offer process analysis suppress the additional complexity of multi-issue negotiations by representing offers only in terms of the (aggregate) utility value which an offer has to a negotiator. Aggregating multi-dimensional offers into one single utility value creates an important advantage for analysis. The differences between utility values of (not necessarily subsequent) offers can be interpreted as a

cardinal measure of concessions made by a negotiator. Concessions are perhaps one of the most widely studied quantitative characteristics of negotiation processes.

Given the importance of offers for negotiations, it is not surprising that offer process analysis covers the entire range of granularity levels, from the micro level of single offers to the macro level of entire negotiations. We will discuss these levels in turn, starting (mainly for historical reasons) from the macro level.

At the macro level, the total concession made by a party (i.e. the difference in utility between the first and the last offer made by that party, or the first offer and the final compromise which the party has accepted) is a straightforward indicator of the party's behavior during the negotiation. Carnevale and Pruitt (1992) and Druckman (1994) give an overview of the empirical research on concession behavior. This research has identified several factors influencing concessions. Apart from individual characteristics of the negotiators, like their hostility (Carnevale and Pruitt, 1992), and problem characteristics, like the framing of the problem in terms of gains or losses (Carnevale, 2008), time pressure has been identified as one of the most important external factors influencing total concessions (Stuhlmacher and Champagne, 2000).

In addition to the total magnitude of concessions, researchers also considered the frequency of concessions, measured by the fraction of offers that actually are concessions in contrast to offers in which a negotiator demands a constant or even higher utility for herself, and the average size of individual concessions as process characteristics (Stuhlmacher and Champagne, 2000). While all these measures were used for single-issue negotiations or applied to utility values in multi-issue negotiations, Vetschera (2006, 2007) considered concessions in individual issues and related them to the importance of issues as represented by their weights in the negotiators' utility functions.

In contrast to concessions, which are a widely used process characteristic, the actual values involved in individual offers were rarely analyzed. One exception is Carnevale (2008), who used average utility values of offers, both to the focal negotiator and to the opponent as well as the sum of both, as an additional process characteristic and found that these values are related to the framing of the problem as gains or losses. In multi-issue negotiations, the structure of package

offers involving several issues also allows to infer the priorities of issues to each party. This relationship has been used by Vetschera (2009) to measure the information about preferences of negotiators that can be inferred from observing their offers.

The total amount of concessions (as well as the other aggregate measures discussed so far) provides a rather coarse-grained representation of the negotiation process. A finer level of granularity is provided by measures which take into account the time structure of offers (or concessions). In particular, the relationship between initial first offer and subsequent concessions, as well as the development of concessions over time, have been studied empirically. Both areas of research are surveyed by Carnevale and Pruitt (1992). They provide empirical evidence about different types of negotiation strategies and, based on these empirical results, recommend an "inverted-U" strategy, which is characterized by a tough initial offer and a relatively high rate of concessions in the middle of negotiations, with lower concession rates at the beginning and the end of the negotiation.

While the research reported by Carnevale and Pruitt (1992) is mainly based on the actual concession patterns observed during (experimental) negotiations, other researchers have used different approaches. Henderson et al. (2006) used predefined patterns for a given concession (like a constant rate of concession, conceding the entire amount right at the beginning or only at the end of the negotiation) and presented those patterns to experienced negotiators asking them about their preferences for each of them. In an empirical survey of over 10,000 negotiators across the world, they found distinctively different preferences for concession patterns among different cultures.

A more general approach to characterize observed concession and offer patterns was developed by Nastase (2006), who interpreted the utility values of offers as a function of time. Several characteristics of these "concession curves" were used as input to a machine learning classification mechanism to test whether these characteristics jointly determined the success or failure of negotiations. Accuracy rates of over 70% were obtained with this approach.

An alternative method to characterize entire negotiations in terms of concession processes was developed by Tutzauer (1993). All offers from one negotiator are described as a curve in utility space, representing the utility values of the offers to both parties. Toughness of

a negotiator is then measured by a line integral along this concession curve.

At the meso-level the dyadic interaction, i.e., the sequence of one offer from a negotiator and the counteroffer from her opponent, becomes the focal unit of analysis. Although interaction dyads seem to be a quite natural building block for studying negotiations, very little research has been performed at this level up to date. A theoretical framework for analysis at this level was developed by Tutzauer (1986), who introduced the concept of an "offer-response function". An offer-response function represents the counter-offer of a negotiator's opponent as a function of the preceding offer of the negotiator (and vice versa for the other side). This concept allows for the formalization and analysis of many concepts in negotiations. For example, a compromise can be interpreted as a fixed point of an offer-response function, and reciprocity can be represented by the condition that offers which are closer to such a fixed point be matched by counter-offers which are also closer to the compromise. For empirical tests of the model, parameterized specifications of the offer-response function must be used. Tutzauer (1986) used elliptic functions and was able to show that the estimated parameters of the offer-response functions differed significantly between successful and failed negotiations. Despite these encouraging results, this approach has not been applied since in empirical studies.

Taking a less formal perspective, one can study the relationship between offers and counteroffers from an empirical point of view, using models of descriptive decision theory. Kristensen and Gärling (2000) analyzed whether previous offers from the opponent form an anchor point, which influences subsequent offers by a negotiator through insufficient adjustment from the anchor. In their empirical study, this anchoring effect was confirmed. In the context of multi-issue negotiations, Moran and Ritov (2002) also found a strong anchoring effect of the first offer made during a negotiation on the counteroffers by the opponent.

At the micro level, offer process analysis deals either with single offers from a negotiator, or the relationship between two subsequent offers from the same negotiator, which represents a single "bargaining step" made by that negotiator.

The initial offer plays a particular role in negotiations. Although the importance of initial offers and their impact on negotiation outcomes is clearly

recognized both in the academic (Cellich, 2000; Half, 1993) and the practical (Buelens and Poucke, 2004) literature, factors which determine the initial offer have been studied only rarely. One exception is Buelens and Poucke (2004), who found that knowledge of the opponents BATNA is an important factor in determining initial offers.

In the negotiation process following the initial offer, the relationship between two subsequent offers is often considered to be more important than the actual issue values contained in them. In single issue negotiations, such bargaining steps can only be classified into concessions and "inconsistent" offers (Stuhlmacher and Champagne, 2000), which represent increasing demands by a negotiator. In the context of multi-issue negotiations, more complex patterns can be distinguished because of the possibility of log-rolling. Filzmoser and Vetschera (2008) and Gimpel (2007) developed similar classification schemes for bargaining steps in multi-issue negotiations which distinguish four types:

- *Insistence* (similarity): offers which do not differ from previous offers.
- *Concession*: offers in which the negotiator concedes in at least one issue without strengthening her position in any other issue.
- *Demand* (Step back): Offers in which the negotiator increases her demand in at least one issue, without decreasing it in any issue.
- *Trade-off*: Offers in which the negotiator increases her demand in some issues and reduces it in others.

In their empirical study, Filzmoser and Vetschera (2008) confirmed that insistence has a negative effect on both the likelihood of reaching an agreement and the Pareto efficiency of agreements, thus establishing a link between process characteristics and outcomes. Existing classification schemes for bargaining steps treat all issues equally, future extensions could involve classification schemes which take into account the different importance of issues to negotiators.

Summarizing the current state of offer process analysis, we notice that this approach is particularly well developed at the macro level, where several aggregate measures characterizing the entire negotiation process have been developed and employed in numerous empirical studies. Research at the micro level, considering individual offers and bargaining steps is, with the

exception of research on initial offers, still at a rather early stage, and at the meso-level there have been even fewer contributions.

Time Series Analysis

Time series analysis is a set of statistical methods to analyze quantitative variables that are measured at different (typically discrete) points in time. The most common use of time series analysis is to forecast future values of the variables, but time series analysis models can also be used to explain relationships between variables and the development of variables over time. Time series models can broadly be classified into univariate models, which are mostly used to predict future values of one variable using past data of the same variable; and multivariate models, which take into account relationships between (past and present) values of several variables. Time series analysis methods usually require data to be measured on a metric scale. Thus they could be applied to data on offer values, but also to qualitative data about communication content, which is transformed to quantitative data by considering e.g. frequencies of certain communication acts in given time periods. Since time series models need to be fitted to an entire time series, which usually corresponds to data on an entire negotiation or a large part thereof, we classify them as meso- to macro-level methods.

A technical introduction to the methods of time series analysis with a particular emphasis on their application to communication processes and social interactions is given by Gottman (1979). We therefore do not describe specific methods here, but focus on applications of time series analysis in negotiation research.

As a prediction method, time series analysis could be used in the context of negotiation support to help one negotiator to predict future moves of the opponent. While to our knowledge, no such applications of time series analysis exist (yet), a similar approach was considered by Carbonneau et al. (2008), who used an artificial neural network to predict the opponent's offer based on information about past offers and the focal negotiator's current offer. This model then was used to optimize the focal negotiator's offer strategy.

While the use of univariate models is mostly restricted to prediction, multivariate models can also be

used for explanation. An important advantage of time series models is that they explicitly model the lag structure involved in the interaction of variables, which can also help to explore complex patterns of relationships and causal structures between the variables involved. Important tools in time series analysis are autocorrelation and cross-correlation functions, which plot correlation between lagged values of the same (autocorrelation) or different (cross-correlation) variables as a function of the time lag between observations.

An exemplary application of these methods to the analysis of negotiations is the work of Gerner and Schrodt (Gerner and Schrodt, 2001; Schrodt and Gerner, 2004), who used cross-correlation functions to study the causes and impact of different types of mediation in political conflicts like the Middle East conflict or the wars in the Balkans in the 1990s. By calculating the cross-correlation function between the intensity of mediation efforts and conflict characteristics, like the level of tension, they were able to show that mediation was often triggered by a preceding high level of conflict and that different types of mediation (and mediation by different parties) differed significantly in their impact on the cooperation levels between parties involved.

An important concept of time series analysis, which to our knowledge has not yet been applied to study negotiations, is the separation of the dynamics of a time series into a trend, a seasonal (or more general, cyclical), and a random component. While researchers in negotiations have used techniques such as regression analysis or simple pairwise tests between different phases of negotiations to identify trends and changes in variables over time, the potential of time series analysis to identify cyclical patterns in temporal data has not yet been exploited. In time series analysis, data is not only analyzed in the time domain (where each observation is identified by its time index), but also in the frequency domain. For analysis in the frequency domain, a time series is transformed into its spectrum showing the relative strength of oscillations of different frequencies. Spectral analysis could help negotiation researchers to identify recurring patterns in negotiations. One potential problem in the spectral analysis of negotiations is the data requirement. Typically data involving several cycles is needed before a cyclical pattern can be established. Thus spectral analysis is not able to replace conventional phase analysis (in which phases are assumed to occur just once in a negotiation),

but could identify more frequent patterns at the micro level. Because of the necessity to use long data series, time series methods can be applied to negotiation data only at the macro level of entire negotiations.

Information Theory and Grammar Complexity

The core of each negotiation process is the exchange of information between parties. Therefore, information theory can provide useful tools for studying negotiations. The fundamental concepts of information theory were already established over 60 years ago by Shannon (1948). However, researchers in negotiation have only recently begun to exploit this possibility. One possible explanation for this long delay is the need to establish a linkage between the formal structure provided by information theory and actual negotiation processes.

Information theory, as it was formulated by Shannon, is concerned with the transmission of messages (like texts) over a (technical) medium. Messages consist of a string of symbols which are taken from a given alphabet. When analyzing negotiations it would not make much sense to study communication processes at the level of single letters contained in messages sent via an e-negotiation system. Modern methods of content analysis, however, allow to represent a negotiation as a stream of categorized communication units. In this interpretation, categories used to code the communication units form the alphabet in the terminology of information theory, and each communication unit (thought unit) is considered as one symbol being transmitted between negotiators.

A central concept in Shannon's information theory is entropy. The composition of a transmitted message is supposed to be a random process in which each symbol of the alphabet appears with a certain probability. The alphabet contains n symbols, and symbol i occurs with probability p_i . An optimal encoding for the alphabet would need $-\log_2 p_i$ bits for symbol i , so this quantity represents the amount of information transmitted by that symbol. Frequent symbols thus convey less information than rare symbols. By taking the expected value across all symbols, we obtain the entropy H as (Conant, 1990; Shannon, 1948):

$$H = - \sum_i p_i \log_2 p_i \quad (1)$$

While H is defined in terms of a given alphabet, and thus considered as a property of the alphabet, the same measure can also be applied to a single message by replacing the theoretical probability p_i by the relative frequency of a symbol in a given message or a set of several messages.

The entropy takes its maximum value when all symbols occur with equal probability. A low value of entropy indicates that certain symbols are rather rare and others are quite frequent. Entropy thus is a measure indicating how uniform a communication process is.

Interpreting a negotiation as a sequence of coded communication units, in which each communication unit is one symbol, the entropy of the negotiation can be computed. A low entropy would indicate that the negotiation contained some "surprises" in the form of a certain type of communication occurring perhaps only once or twice during the negotiation, while a high entropy would indicate that all types of communication units were used to a similar extent.

While entropy thus provides a compact overview of the distribution of communication categories in a negotiation, it does not take into account the structure in which symbols are arranged in a message. For example, in a simple alphabet containing only the letters A and B, the following three messages, which are composed of the same number of A's and B's, would all have the same entropy:

A B B A A B A B

A A A A B B B B

A B A B A B A B

However, the second and third sequence clearly follow a more regular pattern than the first one. This "structuredness" of the entire process could be an important factor in a negotiation, which is not captured by entropy.

This aspect is taken into account by measures of complexity based on context-free grammars. In general terms, a grammar is a set of rules specifying how syntactically correct words or sentences are created from symbols in a language. To describe those rules, two classes of symbols are distinguished: terminal symbols, which correspond to the symbols in the alphabet and are the elementary non-decomposable elements of the language, and non-terminal symbols,

which represent higher order constructs. The rules in the grammar specify how non-terminal symbols can be expanded into strings which at the end of the process contain only terminal symbols.

In a context free grammar, rules have the form

$$\sigma \rightarrow q$$

where σ is one nonterminal symbol and q is an arbitrary string composed of terminal and/or nonterminal symbols. Thus a rule in a context free grammar specifies a string by which exactly one nonterminal symbol is to be replaced. This rule can be applied to any occurrence of the nonterminal symbol anywhere in a string. This distinguishes context free grammars from context sensitive grammars, where replacement of a nonterminal symbol is only allowed if the symbol occurs in a certain context. Context free grammars form the middle level in Chomsky's (1956) hierarchy of grammars. At the lowest level, regular grammars are restricted to a certain structure of the right hand side of the replacement rule.

Highly structured sequences can be produced by relatively short grammars. For example, the sequence A B A B A B A B can be produced by the very short rules:

$$\begin{aligned}\sigma_1 &\rightarrow \sigma_2 \sigma_2 \sigma_2 \sigma_2 \\ \sigma_2 &\rightarrow A B\end{aligned}$$

which could be written even shorter as

$$\begin{aligned}\sigma_1 &\rightarrow \sigma_2^4 \\ \sigma_2 &\rightarrow A B\end{aligned}$$

where superscripts indicate the number of replications of identical symbols. On the other hand, a completely random sequence can only be represented by a grammar which contains exactly that sequence as the right hand side of a production rule. Thus, the total length of the right hand sides of the production rules required to create a string is an indicator of the "structuredness" of the string.

More formally, the grammar complexity of a given string is defined as follows (Jiménez-Montaño, 1984):

Denote by $K(\sigma \rightarrow q)$ the complexity of the production rule $\sigma \rightarrow q$, which is defined as the length of the string q on the right hand side of the rule. A grammar N is a set of production rules which are uniquely

identified by their nonterminal symbols σ . Then the complexity of a grammar N defining string r is defined as

$$K_N(r) = \sum_{\sigma \in N} K(\sigma \rightarrow q) \quad (2)$$

i.e. the sum of the lengths of all right hand sides of the production rules needed to generate string r .

Since a string can be generated by many different sets of production rules, Chaitin (1966) proposed to use the shortest length of any grammar describing string r :

$$K_G(r) = \min_N K_N(r) \quad (3)$$

Thiele (1974) provided an axiomatic foundation for this measure. While it can be shown that it is not possible to prove that a given grammar is actually the shortest description for a given string (Chaitin, 1974), this is not a severe restriction for the concept. As long as a reasonably good algorithm for constructing a set of rules is consistently applied to all data under study, the length of the resulting rules can be used as a consistent measure of complexity. One such algorithm is presented in Schneidereiter (1974), who uses a "redundancy value" based on the length and frequency of patterns found in a string to determine which pattern to replace by a nonterminal symbol. The resulting measures of complexity have been applied to several different fields including biology (Jiménez-Montaño, 1984) and interactions between patient and therapist in psychotherapy (Rapp et al., 1991).

In negotiation analysis the structure of communication processes is also of importance. So far, however, structure has mainly been analyzed in terms of patterns of words or phrases (see our section on discourse analysis). While these methods concentrate on single words or phrases exchanged during negotiation, measures like grammar complexity can be used to consider different types of communication units as symbols and study their relationships. Grammar complexity was applied to coded transcripts of e-negotiations by Griessmair et al. (2008), who found significant differences in grammar complexity between negotiations supported by analytical tools and negotiations in which only communication tools were used, as well as between successful and failed negotiations.

Grammar complexity and related measures treat the entire negotiation as the basic unit of analysis and thus were placed at the macro level of analysis in Fig. 1.

Discussion

In this chapter, we have attempted to provide a comprehensive overview of different methods which can be used to *analyze negotiation processes*. The methods we have presented originated in a wide variety of scientific fields and encompass a broad spectrum of different viewpoints on negotiations.

As we have already argued, we view this diversity as a strength rather than as a weakness of the field and we expect that even for rather specific and focused research questions, a combination of several methods will be required. Using such a multi-method approach can be supported both by theoretical and pragmatic arguments:

From a theoretical perspective, the diversity of methods is required to cope with the complexity of the research object. Negotiation processes are complex, multidimensional phenomena, which can and must be studied from a variety of perspectives. Each of the methods we have presented highlights a particular aspect of the negotiation process. Methods which focus on communication about the substantive aspects of the negotiation like offer values emphasize the quantitative part of the communication. Inclusive methods also consider qualitative aspects of communication, but consequently can represent communication only at a rather general level (e.g. in frequency analysis, one only models the fact that a particular statement from a negotiator contains an offer, without reference to the actual values involved). Thus, a combination of methods is needed to obtain a comprehensive view. In particular, the linkage between the substantive level of negotiations and the qualitative and relationship-oriented aspects of communication is still largely unexplored and can only be understood if methods from both domains are combined in innovative ways.

Even when methods cover the same or similar aspects of the negotiation problem, a combination of methods could be useful. Several of the methods we have discussed involve subjective components in the classification and evaluation of data. Methods

involving analytical components typically also require simplifications and the choice of parameters, which might introduce noise and biases into the results. Triangulation by using different methods is therefore an important strategy to improve the reliability and validity of results.

Apart from these theoretical arguments, there are also pragmatic reasons for a multi-method approach. Several of the methods we have discussed operate on coded interaction data. Coding of negotiation transcripts is a complex and labor-intensive process. By applying different methods to data obtained from qualitative content analysis, the resources spent for coding are used more efficiently.

As our survey has indicated, the application of several of the methods which we have discussed to negotiation data and negotiation processes is still in its infancy. The huge effort required for coding and preparation of data is perhaps one of the limiting factors which inhibit a more wide-spread use of these techniques. Therefore, approaches to overcome these data limitations are an important topic in the future development of methods to analyze negotiation processes. While several attempts were already made to apply methods of computational linguistics, text mining and machine learning to the classification of negotiation transcripts, success so far has been limited. Many methods for process analysis require a deeper understanding of human interactions, which so far can not be provided by automated systems. However, interactions in negotiations also contain many routine elements, to which such methods could be applied. This could lead to a division of labor between humans and computers in the analysis of negotiations enabling the handling of larger amounts of negotiation data than previously possible, without sacrificing rigor or quality of insight.

Innovative methods could also complement existing research on negotiation processes in entirely different ways. Rather than uncovering the structure of observed negotiation processes, simulation methods could be used to analyze whether assumed mechanisms can indeed generate patterns which are similar to those observed in actual negotiations.

Although the need for more process-oriented research on negotiations has been articulated in the literature for several decades, we still can conclude with the remark that this is a very dynamic field, offering plenty of opportunities for both the development of new methods, and innovative applications of existing methods.

References

- Adair WL, Brett JM (2005) The negotiation dance: time, culture, and behavioral sequences in negotiation. *Organ Sci* 16:33–51
- Allison PD, Liker JK (1982) Analyzing sequential categorical data on dyadic interaction. A comment on Gottman. *Psych Bull* 91:393–403
- Brennan RL, Prediger DJ (1981) Coefficient kappa: some uses, misuses, and alternatives. *Educ Psych Meas* 41:687–699
- Buelens M, Poucke DV (2004) Determinants of negotiator's initial opening offer. *J Bus Psych* 19:23–35
- Carbonneau R, Kersten GE, Vahidov R (2008) Predicting opponent's moves in electronic negotiations using neural networks. *Expert Syst Appl* 34:1266–1273
- Carnevale PJ (2008) Positive affect and decision frame in negotiation. *Group Decis Negotiation* 17:51–63
- Carnevale PJ, Pruitt DG (1992) Negotiation and mediation. *Annu Rev Psych* 43:531–582
- Cellich C (2000) Business negotiations: making the first offer. *Int Trade Forum* 2000:12–16
- Chaitin GJ (1966) On the length of programs for computing finite binary sequences. *J ACM* 13:547–569
- Chaitin GJ (1974) Information theoretic computational complexity. *IEEE Trans Inf Theor* 20:10–15
- Chomsky N (1956) Three models for the description of language. *IRE Trans Inf Theor* 2:113–124
- Conant RC (1990) Information laws of systems. In: Sage AP (ed) *Concise encyclopedia of information processing in systems and organizations*. Pergamon Press, Oxford
- Condon SL, Cech CG (1996) Discourse management strategies in face-to-face and computer-mediated decision making interactions. *Electr J Comm* 6:online
- Condon SL, Cech CG (2001) Profiling turns in interaction: discourse structure and function. In: 34th international conference on system sciences. IEEE, Hawaii, p10
- Condon SL, Cech CG, Edwards WR (1999) Measuring conformity to discourse routines in decision-making interactions. In: *Human language technology conference of the NAACL*. ACL, New York, NY
- Donohue WA (1981a) Analyzing negotiation tactics: development of a negotiation interact system. *Hum Commun Res* 7:273–287
- Donohue WA (1981b) Development of a model of rule use in negotiation interaction. *Commun Monogr* 48: 106–120
- Donohue WA, Diez ME, Hamilton M (1984) Coding naturalistic negotiation interaction. *Hum Commun Res* 10: 403–425
- Druckman D (1994) Determinants of compromising behavior in negotiation – a meta-analysis. *J Conflict Resolut* 38: 507–556
- Druckman D (2003) Linking micro and macro-level processes: interaction analysis in context. *Int J Conflict Manage* 14: 177–190
- Druckman D, Hopmann T (2002) Content analysis. In: Kremenjuk VA (ed) *International negotiation: analysis, approaches, issues*. Jossey-Bass, San Francisco, CA
- Fitzmoser M, Vetschera R (2008) A classification of bargaining steps and their impact on negotiation outcomes. *Group Decis Negotiation* 17:421–443
- Flick U (2009) *An introduction to qualitative research*. Sage, London

- Folger J, Hewes D, Poole M (1984) Coding social interaction. In: Dervin B, Voight M (eds) *Progress in communication sciences*. Ablex, Norwood, NJ
- Friedman R (2006) Studying negotiations in context: an ethnographic approach. In: Carnevale P, DeDreu CKW (eds) *Methods of negotiation research*, Martinus Nijhoff Publishers, Leiden/Boston
- Gerner DJ, Schrodt PA (2001) Analyzing the dynamics of international mediation processes in the Middle East and the former Yugoslavia. Department of Political Science, University of Kansas, Lawrence, KS
- Gimpel H (2007) Preferences in negotiations – the attachment effect. Springer, Berlin
- Gottman JM (1979) Time-series analysis of continuous data in dyads. In: Lamb ME, Suomi SJ, Stephenson GA (eds) *Social interaction analysis*. University of Wisconsin Press, Madison, WI
- Griessmair M, Koeszegi ST, Vetschera R (2008) The grammar complexity and entropy of e-negotiation processes: an empirical analysis. In: Climaco J, Kersten GE, Costa JP (eds) *Group decision and negotiation*. Coimbra, Portugal, pp 185–186
- Half R (1993) How do I negotiate a salary increase. *Manage Acc* 75:13
- Harris KL (1996) Content-analysis in negotiation research – a review and guide. *Behav Res Meth Ins C* 28: 458–467
- Henderson MD, Trope Y, Carnevale PJ (2006) Negotiation from a near and distant time perspective. *J Pers Soc Psychol* 91:712–729
- Holmes ME (1992) Phase structures in negotiation. In: Putnam LL, Roloff ME (eds) *Communication and negotiation*. Sage Publications, Newbury Park, CA
- Holmes ME (1997) Optimal matching analysis of negotiation phase sequences in simulated and authentic hostage negotiations. *Commun Rep R*:1–8
- Holmes ME, Poole MS (1991) Longitudinal analysis. In: Montgomery BM, Duck S (eds) *Studying interpersonal interaction*. Guilford Press, New York, NY
- Holsti OR (1969) Content analysis for the social sciences and humanities. Addison-Wesley, Reading, MA
- Jiménez-Montaño MA (1984) On the syntactic structure of protein sequences and the concept of grammar complexity. *Bull Math Biol* 46:641–659
- Johnston LM (2005) Narrative analysis. In: Druckman D (ed) *Doing research: methods of inquiry for conflict analysis*. Sage, Thousand Oaks, CA
- Keough CM (1992) Bargaining arguments and argumentative bargaining. In: Putnam LL, Roloff ME (eds) *Communication and negotiation*. Sage, Newbury Park, CA
- Koeszegi ST, Pesendorfer E-M, Vetschera R (2009) Episodic phase analysis of synchronous and asynchronous e-negotiations. *Group Decis Negotiation*. doi:10.1007/s10726-008-9115-0
- Koeszegi ST, Srnka KJ, Pesendorfer E-M (2006) Electronic negotiations: A comparison of different support systems. *Die Betriebswirtschaft* 66:441–463
- Kristensen H, Gärling T (2000) Anchor points, reference points, and counteroffers in negotiations. *Group Decis Negotiation* 9:493–505
- Lewicki RJ, Litterer JA (1985) *Negotiation: readings, exercises, and cases*. Irwin, Homewood, IL
- Lincke A (2003) Electronic business negotiation: some experimental studies on the interaction between medium, innovation context and culture. ECIS, Eindhoven
- Macdonald C (2003) The value of discourse analysis – as a methodological tool for understanding a land reform program. *Policy Sci* 36:151–173
- Martinovski B, Mao W (2009) Emotion as an argumentation engine: Modeling the role of emotion in negotiation. *Group Decis Negot* 18:235–259
- Martinovski B, Traum D, Marsella S (2007) Rejection of empathy in negotiation. *Group Decis Negotiation* 16: 61–76
- Mayring P (2002) Qualitative content analysis – research instrument or mode of interpretation? In: Krieglmann M (ed) *The role of the researcher in qualitative psychology*. Huber, Tübingen
- Moran S, Ritov I (2002) Initial perceptions in negotiations: evaluation and response to 'logrolling' offers. *J Behav Dec Making* 15:101–124
- Nastase V (2006) Concession curve analysis for Inspire negotiations. *Group Decis Negotiation* 15:185–193
- Neu J (1988) Conversation structure: an explanation of bargaining behaviors in negotiation. *Manage Commun Q* 2:23
- Olekals M, Brett JM, Weingart LR (2003) Phases, transitions and interruptions: modeling processes in multi-party negotiations. *Int J Confl Manage* 14:191–211
- Olekals M, Smith PL (2000) Negotiating optimal outcomes: the role of strategic sequences in competitive negotiations. *Hum Commun Res* 24:528–560
- Olson GM, Herbsleb JD, Rueter HH (1994) Characterizing the sequential structure of interactive behaviors through statistical and grammatical techniques. *Hum-Comput Interact* 9:427–472
- Poole MS, Roth J (1989) Decision development in small groups IV. A typology of group decision paths. *Hum Commun Res* 15:323–356
- Putnam LL (2004) Dialectical tensions and rhetorical tropes in negotiations. *Organ Stud* 25:35–53
- Putnam LL (2005) Discourse analysis: mucking around with negotiation data. *Int Negot* 10:17–32
- Putnam LL, Jones TS (1982a) Reciprocity in negotiations: an analysis of bargaining interaction. *Commun Monogr* 48: 171–191
- Putnam LL, Jones TS (1982b) The role of communication in bargaining. *Hum Commun Res* 8:262–278
- Rapp PE, Jimenez-Montano MA, Langs RJ et al (1991) Toward a quantitative characterization of patient-therapist communication. *Math Biosci* 105:207–227
- Schneidreiter U (1974) Zur Beschreibung strukturierter Objekte mit kontextfreien Grammatiken. In: Klix F (ed) *Organismische Informationsverarbeitung*. Akademie-Verlag, Berlin
- Schrodt PA, Gerner DJ (2004) An event data analysis of third-party mediation in the Middle East and Balkans. *J Conflict Resolut* 48:310–330
- Seligmann LJ (2005) Ethnographic methods. In: Druckman D (ed) *Doing research. Methods of inquiry for conflict analysis*. Sage, Thousand Oaks, CA
- Shannon CE (1948) A mathematical theory of communication. *Bell Syst Tech J* 27:379–423, 623–656
- Simons T (1993) Speech patterns and the concept of utility in cognitive maps: the case of integrative bargaining. *Acad Manage J* 36:139–156

- Smith PL, Olekalns M, Weingart LR (2006) Markov chain models of communication processes in negotiation. In: Carnevale P, De Dreu CKW (eds) *Methods of negotiation research*. Martinus Nijhoff Publishers, Leiden/Boston
- Sokolova M, Szpakowicz S (2007) Strategies and language trends in learning success and failure of negotiation. *Group Decis Negotiation* 16:469–484
- Srnka KJ, Koeszegi ST (2007) From words to numbers: how to transform rich qualitative data into meaningful quantitative results: guidelines and exemplary study. *Schmalenbach's Bus Rev* 59:29–57
- Stuhlmacher F, Champagne MV (2000) The impact of time pressure and information on negotiation process and decisions. *Group Decis Negotiation* 9:471–491
- Thiele H (1974) Zur Definition von Kompliziertheitsmaßen für endliche Objekte. In Klix F (ed) *Organismische Informationsverarbeitung*, Akademie-Verlag, Berlin
- Thompson LL (1990) Negotiation behavior and outcomes: empirical evidence and theoretical issues. *Psychol Bull* 108:515–532
- Tutzauer F (1986) Bargaining as a dynamical system. *Behav Sci* 31:65–81
- Tutzauer F (1992) The communication of offers in dyadic bargaining. In: Putnam LL, Roloff ME (eds) *Communication and negotiation*. Sage, Newbury Park, CA
- Tutzauer F (1993) Toughness in integrative bargaining. *J Commun* 43:46–62
- Vetschera R (2006) Preference structures of negotiators and negotiation outcomes. *Group Decis Negotiation* 15:111–125
- Vetschera R (2007) Preference structures and negotiator behavior in electronic negotiations. *Decis Support Syst* 44:135–146
- Vetschera R (2009) Learning about preferences in electronic negotiations – a volume based measurement method. *Eur J Oper Res* 194:452–463
- Weingart LR, Brett JM, Olekalns M et al (2007) Conflicting social motives in negotiating groups. *J Pers Soc Psychol* 93:994
- Weingart LR, Olekalns M (2004) Communication processes in negotiation: frequencies, sequences, and phases. In: Gelfand MJ, Brett JM (eds) *The handbook of negotiation and culture*. University Press, Stanford, CA
- Weingart LR, Olekalns M, Smith PL (2004) Quantitative coding of negotiation behavior. *Int Negotiation* 9:441–455
- Weingart LR, Prietula MJ, Hyder EB et al (1999) Knowledge and the sequential processes of negotiation: a Markov chain analysis of response-in-kind. *J Exp Soc Psychol* 35:366–393
- Womack DF (1990) Communication and negotiation. In: O'Hair D, Kreps GL (eds) *Applied communication theory and research*. Lawrence Erlbaum Associates, Hillsdale, NJ

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Editors

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The growing field of Group Decision and Negotiation is best described as the empirical, formal, computational, and strategic analysis of group decision-making and negotiation, especially from the viewpoints of Management Science and Operations Research. The topic crosses many traditional disciplinary boundaries. It has connections to business administration and business strategy, management science, systems engineering, computer science, mathematics, and law, as well as economics, psychology, and other social sciences.

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ISBN 978-90-481-9096-6



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