

# Constructing a Network of Shared Agreement: A Model of Communication Processes in Negotiations

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**Abstract** Traditional, static negotiation theories focus on descriptions of various external factors that influence the outcome of negotiations. They are useful in predicting the negotiation outcome in a limited way, because the result of the negotiation is ultimately determined not only by objective facts, but is worked out during the negotiation itself. We propose a Dynamical Negotiation Network (DNN) model that links the negotiation outcome with the process of attaining that outcome. This model represents the negotiation process in terms of a dynamically constructed network of interconnected nodes of meaning. The structure of the network and dynamics of its creation determine the outcome of a negotiation. In the presented study, we examined 58 participants who negotiated in dyads. There were many objective facts; those that were taken into consideration, the order they appeared in the negotiation, what structure of relationships they formed, helped determine a ‘shared reality’ that drove negotiation outcomes. We show that the DNN model explains the outcomes of their negotiations more precisely than do the static elements of the situation.

**Keywords** Negotiation · Bargaining · Negotiation outcomes · Shared reality · Networks · Semantic networks · Dynamical negotiation networks · Group decision making · Dynamical systems · Complex systems

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## 1 Introduction

Negotiation can be examined from two perspectives: either static—the entire situation of the negotiation, or dynamic—the process of getting to an agreement. The static perspective is widely described in the negotiation literature and it is known how various factors of the negotiation situation (like structure of interests, power, relations between parties, available alternatives, strategies etc.) influence the outcome of a negotiation. On the other hand, we still lack much information about the dynamics of the negotiation process, during which parties develop a shared perception of the negotiation situation. Moreover, it is unclear how this process leads to the outcome of the negotiation. A formal description of a jointly created perception of the negotiation is relatively difficult; however, contemporary methods of knowledge representation allow a precise description of the process and the dynamics of the creation of a shared perception during the course of a negotiation. In this article we propose a method of description of the dynamics of the negotiation process and show that this method allows for an enhanced understanding of how these processes affect the outcome of the negotiation.

During negotiation, parties need to create a common understanding of the negotiated problem to be able to reach an agreement (Messick 1999; Pinkley and Northcraft 1994; Thompson and Loewenstein 1992). The structure of this understanding designates the outcome of the negotiation. In social psychology, such a common structure is called a shared reality and the process of creating it is one of the fundamental processes of human cognition (Hardin and Higgins 1996). Although the process of creating a shared reality is crucial for human perception of the real world, the notion itself lacks precision; not only is there a scarcity of methods allowing measurement of the shared reality, but also there are no methods that allow measurement of dynamic aspects of shared reality creation, nor ways to relate it to the outcome of the negotiation.

We claim that the emergence of a shared reality during a negotiation and the dynamics of its change can be successfully analyzed in terms of evolving networks of knowledge. In such networks bits of information (facts, beliefs, objects etc.) can be represented as nodes, whereas relations between these elements can be represented as links between the nodes. In these terms, a negotiation process is tantamount to the collaborative building of a Dynamical Negotiation Network (DNN), where each party tries to influence the shape of the network in a way that leads to a more favorable solution for them. We will show that there is a strong relation between the DNN constructed during a negotiation and the outcome of the negotiation.

Both the formal properties and the content of the DNN have a strong influence on the outcome of the negotiation process. Various negotiation strategies may be analyzed in terms of attempts to influence the shape and the content of the DNN and how they lead to preferred solutions. Modern tools of network analysis from current advances in network science provide means to analyze general properties of the DNNs achieved during negotiations and show the importance of specific elements of the network to the outcome of the negotiation in a precise way. This method fits squarely into the new dynamic approach to negotiations and conflict resolution (Coleman 2006; Coleman et al. 2006, 2007; Nowak et al. 2006) and allows measuring of both the dynamics of the negotiation process and the impact of this process on the outcome of negotiations.

We discuss the relevance of these measures to both the process and the outcome of negotiations.

In this article, we discuss the importance of the negotiation process, in the context of the factors of the negotiation situation, to the outcome of the negotiation. We describe how during the negotiation process parties construct a shared reality and briefly present the network approach. We explain the relation between the created network of shared reality and the outcome of a negotiation. On the basis of an exemplary negotiation, we show how the negotiation process may be understood in terms of the joint construction of networks of knowledge. In the presented experiment, we show that the shared reality created in a negotiation allows for explaining the variance of negotiation outcomes with higher accuracy than the static models.

### 1.1 The Role of the Static Elements on the Negotiation Situation and Outcome

One of the primary goals of negotiation theory is to explain specific outcomes (Zartman 2002). Negotiation is a process of communication, in which parties may fulfill their interests by solving discussed problems (e.g., amount of money for a given product) (Raiffa 1982). This process may be examined from a static perspective of the negotiation situation, where various factors determine a structure and thus an outcome of the negotiation, and from the dynamic perspective of the process, during which parties collaboratively are constructing to the outcome. The first perspective is quite well described in the negotiation literature, whereas we still lack knowledge about how the process of converging the common agreements proceeds (cf. Bazerman et al. 2000).

Theories focus on various factors of the negotiation situation that influence the outcome of a negotiation (Thompson 1990). Among these factors are the power structure of the parties engaged (Bacharach and Lawler 1981; Habeeb 1988; Zartman and Rubin 2000), available strategies (Von Neumann and Morgenstern 1944), alternative solutions (Fisher et al. 1991; Lax 1985; Lax and Sebenius 1991), socioeconomic conditions of the problem (Brandenburger and Nalebuff 2003; Nash 1950; Walton and McKersie 1965), the history of former moves and positions taken (Bartos 1977; Nastase 2006), and personalities of participants (Rubin and Brown 1975). Each of these approaches may be considered separately or in conjunction with other factors. For instance, according to Game Theory (Von Neumann and Morgenstern 1944) each party in a negotiation chooses one of a set of strategies. In this case the outcome of the negotiation depends purely on the strategies that are chosen by each of the engaged parties. Moreover, it is possible to consider more factors that influence the outcome in such a situation. For example, the power structure determines the available strategies and the subsequently chosen strategies determine the outcome of the negotiation. Furthermore, it is possible to take into account personalities of the negotiators (Carnevale and De Dreu 2006; Ma and Jaeger 2005; Rubin and Brown 1975; Rhoades and Carnevale 1999; Steinel and De Dreu 2004; Van Kleef et al. 2004a,b). According to personality models, some people prefer more cooperative, whereas others prefer more competitive strategies. Moreover, negotiators may apply special combinations of their strategies that depend on the former moves of their opponents (Axelrod 1984). In

this way, one may increase the likelihood of choosing the strategy desired by the opponent. Additionally, it is possible to take into account incompleteness of information (Chatterjee and Samuelson 1983) and the effect of biased perceptions of the participants (Kahneman and Tversky 1973; Thompson et al. 2006; Tversky and Kahneman 1974, 1981). We could enrich this discussion about the negotiation situation with more elements that intertwine and influence each other and in the end influence the outcome of the negotiation (for review see Bazerman et al. 2000). The research devoted to these factors of the negotiation situation provides an important contribution to our knowledge about negotiation theory and practice.

However, negotiation is a dynamical phenomenon. The effects of individual factors of a negotiation situation on outcomes may be altered in the course of negotiation. All the aforementioned elements of the negotiation situation converge in the process of negotiation and, by their manifestation in this process, influence the outcome of the negotiation. During a negotiation, some factors emerge and become important, while the other factors fade out and become less important (Kim et al. 2005). For example, at the beginning of a negotiation, one party has a certain perception of factors such as, power structure, its suitable strategies, the strategies of its opponents, and their probable responses to previous moves. This perception should determine the outcomes of the negotiation. Nevertheless, depending on the behaviors of the opponents and the other party's appropriate reactions, the latter's perception of the negotiation situation may be changed. It might be only a slight increase in the beliefs of a party about the negotiation situation, but also perceptions may undergo substantial change, as a result of the dynamics of the negotiation process. In general, the factors of the negotiation situation influence the negotiation process, but it is due to the negotiation process that the outcomes are ultimately achieved.

When may the outcomes of a negotiation vary to a greater degree? Sometimes it is easy to predict the outcomes of a negotiation on the basis of situational factors (Stokman et al. 2000), yet many situations require an analysis of the negotiation process to explain the outcomes. The less complete the sets of information the engaged parties have, and the less consistent these sets of information are, the more important the role of the negotiation process in explaining the negotiation outcomes. Negotiation outcomes may differ from predictions made with situational factors alone for many reasons: incompleteness of information was not reduced in the process of information exchange; parties inefficiently or improperly arranged their trade-offs; as a result of a poor preparation process, one party misunderstood his or her own interests; a party withheld information, which would have allowed a better solution; one party concealed (or was unaware of) information that would change the perceived power structure; parties arrived at a solution that completely changed the situation structure and thus probable outcomes. Each of these examples resulted in a decreased probability of achieving the outcome that is predicted by situational factors. In general, the more parties are open to new information and arrangements in the negotiation process, the more the outcome of a negotiation may divert from the previously predicted one.

The problem of achieving suboptimal outcomes, and thus ones different from those predicted, is embedded in the negotiation situation. The strategies of leading a negotiation may be assigned into one of two groups: creating value and claiming value (Lax and Sebenius 1986). The first group of strategies consists in providing new

information or propositions (to the opponent so that they become shared) that could allow achievement of solutions, increasing utilities of both sides. The second group consists in developing a way of division of the created value. Both processes of creating value and claiming value may occur simultaneously—frequently they are intertwined and interdependent. Information provided by one person during the creating value process is vulnerable to exploitation against him or her by the other party, which could result in a disadvantageous division of the negotiated goods. Therefore, an effective negotiation strategy should entail a skillful combination of providing information and at the same time the introduction of a preferred way of dividing the value. Hence, success in negotiation requires such creation of shared reality that it would enlarge the negotiated value for both parties as much as possible and would also allow division it in a preferable way (Raiffa 1982).

Negotiation research confirms that achieved outcomes frequently diverge from the theoretically optimal ones (cf. Bazerman and Neale 1992). On the one hand, the differences arise from various biases of perception that result from the nature of human thinking (Tversky and Kahneman 1974). On the other hand, they result from ineffective communication processes (Van Boven and Thompson 2003) or the creation of specific representations of reality. Lax and Sebenius (1986) cite the example of negotiation between a city mayor and a cable TV provider. In their negotiations, both parties are afraid of exploitation, and therefore during the talks, stress priorities and possibilities different than their real ones. In consequence, the negotiating parties reach a suboptimal agreement—the agreement that is worse for both sides than it would be if only the parties openly discussed their needs and preferences. These processes manifest themselves in the course of a communication process and affect creating a shared reality, which results in a suboptimal outcome.

From this point of view, the process of negotiation becomes at the same time a challenge and an opportunity for a negotiator. Challenge, because the negotiator should optimally utilize his or her assets (trump cards) (e.g., sources of power). Opportunity, because during the negotiation process, it is possible to weaken or eliminate assets of the opponent. Therefore, the objective structure of a situation is only a departure point to the game of determining an outcome (Lax and Sebenius 2003). Next, in the course of talks, creation of shared reality that would reflect one's strong points and indicate advantageous outcomes is necessary. As the outcomes of negotiation depends on the development of shared reality, during the process of its formation one can gain or lose much, depending on a turn of negotiation talks.

## 1.2 The Dynamics of Constructing a Shared Reality

The “negotiation situation” factors affect participants' perceptions of a negotiation situation. On this basis, the parties create their individual perceptions (Johnson-Laird 1989; Van Boven and Thompson 2003) that have an effect on the process of talks (Thompson and Hastie 1990; Van Boven and Thompson 2003). During this process, negotiators change their perceptions of the negotiated problem (Putnam and Holmer 1992) and their views converge to a shared perception of the problem (i.e., shared reality) (Messick 1999; Thompson and Loewenstein 1992). The shared reality

created during the course of a negotiation influences the process of talks (Pinkley and Northcraft 1994), which in turn influences the shared reality itself (Hardin and Higgins 1996; Thompson and Hastie 1990). In this way, there is a loop of mutual influence between the communication process, the creation of shared reality and the perceptions of the individuals. Thus, the outcome of a negotiation ultimately results from the structure of the shared reality, which in turn, is constructed in the course of talks.

The negotiation process consists in leading a talk in such a way that it results in maximal negotiators' utility (Raiffa 1982). Usually each side prefers a different outcome, possesses different information and interprets this information differently (Pinkley and Northcraft 1994). Moreover, these differences may increase as a result of biases resulting from such factors as, cultural differences, different values, and experiences. During a negotiation, participants are confronted with each others' different perceptions (Putnam and Holmer 1992). In the course of talks the negotiators gradually eliminate these differences between them by creating a shared understanding of the problem. Hence the initial subjective perceptions of the situation converge to a shared perception (Messick 1999)—a shared reality (Hardin and Higgins 1996).

One of the main features of the shared reality created during the negotiation process is its dynamical character (Higgins 1992). New information changes the existing information, which changes our perception again. The incoming information forms a structure of interdependent elements, so that changes of some elements may result in changes of other elements. For example, during the negotiation of a basketball player's salary, the quality of the player may be an important factor in determining his salary. His average points scored per match may, in turn, be an important element in determining his quality, and thus indirectly influence his salary. But parties may just as well stipulate his salary from his susceptibility to contusions, because an injured player cannot play and cannot help a team to win a match. In such a case, high average points scored per match would increase his salary, while a long history of contusions may decrease it. In general, the values of negotiated elements depend on relations with other elements of shared reality and the values of these latter elements. So the structure of relations between elements of shared reality and the determination of their values is important for the outcome of a negotiation.

In summary, the objective and perceived subjective structure of a situation is only the beginning for the process of reshaping perceptions of engaged parties, creating a shared reality and the determination of the negotiation outcome. Thus, there are a lot of opportunities for altering the outcome of a negotiation during the process of talks. An analysis of the process of creation, and analysis of a structure of shared reality can answer the question of how the outcomes of a negotiation are influenced throughout the communication process (Harris 1996). Moreover, the systematic analysis of this process allows forming concrete indications for improving one's outcome by creating a shared reality in a negotiation.

### 1.3 Current Tools for Negotiation Process Analysis

The demand for focusing on process analysis has already been formulated by researchers addressing content analysis (Harris 1996; Druckman 2002) and various tools have

been designed to study negotiation processes (Druckman 2005). Research carried out with use of these methods has provided much insight into understanding the negotiation process. For example, comparison of peace processes in Nagorno-Karabakh and Mozambique revealed that the former was dominated by competitive behaviors, the latter by mixed-motive talks, which resulted in more peaceful agreement and improved relations (Druckman and Lyons 2005). There are data showing that the negotiation process may be conducted in different ways and lead to similar immediate outcomes, but results in different levels of satisfaction or long term effects (e.g., Druckman et al. 1998; McGillicuddy et al. 1987). Content analysis was used to compare real-world negotiations with the simulations. For example, during real-world negotiations parties performed similar patterns of positive reactions as in simulations, but in the former case they displayed more strategic maneuvering (Bales and Strodtbeck 1951). Also being a member of a coalition entailed increased frequency of competitive statements (Beriker and Druckman 1996). These methods were also used to obtain general inferences about negotiation processes. For instance: the more parties differ in the amount of severe behavior, the higher the probability of crisis in negotiation (Druckman 1986); negotiators respond based on the similarity of behaviors in previous moves (with respect to behaviors: hard versus soft, agree-disagree, and positive-negative affect) (Beriker and Druckman 1996); limited liking of the other negotiation party is connected to increased verbal cooperation and appeals to joint gains (Druckman and Broome 1991). Apart from that, it is possible to examine gender (Walters et al. 1998) or intercultural differences (Roemer et al. 1999) by means of content analysis.

Classic methods of content analysis assign individual behaviors in a negotiation into appropriate categories, which have previously been defined (Harris 1996). "The resulting data can be used to capture general strategies employed by negotiators (through frequency analysis), how they employed those strategies (through sequential analysis), and when they did so (through phase analysis)" (Weingart et al. 2004, p. 442). First, content analysis methods were devised for single purpose studies, like McGrath and Julian (1963), who divided negotiators' behaviors into three affective categories: positive, negative and neutral. The method of Pruitt and Lewis (1975) focused on aspects of integrative negotiation and codes such behaviors as: information exchange, calling for concessions, using pressure, proposing general approach, showing concern, and proposing coordination. One of the widely used coding systems is Bargaining Process Analysis (Walcott and Hopmann 1978), which was systematically modified by various researchers (cf. Harris 1996). The original system consisted of four broad categories: substantive behavior, strategic behavior, task behavior, and affective behavior. The Conference Process Analysis (Morley and Stevenson 1977) distinguishes between the mode of specific information exchange (offer, accept, reject, seek) and what kind of information was exchanged (procedural, offers, limits, elements of outcomes, acknowledgements etc.). Furthermore, this method notes the reference of the transmitted information (none, self, another party, both parties etc.). On the basis of existing models, Weingart et al. (1990) designed their own system that mainly differentiated between cooperative and competitive behaviors, by assignment of behaviors to nine categories, and was further developed in subsequent works (Weingart et al. 1993, 1996). The aforementioned models are able to examine the dynamics of the negotiation process, but they fail to connect it with the outcomes of negotiations in a



causal way. Thus, they are merely capable of simple predictions so that some kinds of behaviors would probably result in a reduced probability of achieving agreement. This is mainly because of the impossibility of capturing a structure of created shared reality in negotiations.

#### 1.4 Semantic Networks

The negotiation literature also describes the possibility of applying semantic networks to the analysis of the negotiation processes (Carley 1997; Young 1996). The idea of representation knowledge as a network is well-known and there are models widely used in many areas of social sciences (for a review see Sowa 2000). In this paradigm, not only are particular elements of knowledge important, but also the structure of relationships between them. Nodes of a network represent chunks of knowledge and ties—relations between them. Such networks may represent a knowledge set of any size, so they could potentially represent any case of negotiation. Classic models lack ability to make other inferences than those already embedded in a network (Johnson-Laird et al. 1984). In addition, semantic networks are adapted to represent purely static structures of knowledge. They fail to address the dynamic aspects of creating the negotiation shared reality and hence to properly justify the outcome of the negotiation.

Recently, network science is undergoing a variety of developments (c.f. Barabasi 2002; Newman et al. 2006). Many universal characteristics of networks structure have been discovered (Watts and Strogatz 1998; Barabasi and Albert 1999) and appropriate methods of discerning different types of structures have been developed (Park and Barabasi 2007; Milo et al. 2002). Most of all, the emphasis has been put on the dynamics of network formation and emergence of particular types of structures in networks (Newman et al. 2006; Doreian and Stokman 1997; Watts 2003). The DNN model is consistent with the current developments in network science; it fulfills the dynamic conditions for describing a negotiation process; and it is free from the limitations of classic semantic networks, and (as we will show) it can explain the outcome of a negotiation more precisely than situational factors alone.

#### 1.5 Dynamical Negotiation Network Model

In the DNN model, negotiation shared reality is represented as a semantic network that is dynamically constructed in the course of a negotiation. In such a network, separate issues are represented by nodes, while relations between these issues are represented by links between the appropriate nodes. Thus, the process of negotiation consists in jointly creating a network of shared reality. This constructed shared reality is represented by a network of interconnected nodes that influence each other's activation states. From this perspective, the solution of a negotiated problem is a result of jointly constructed connections between particular elements of specific values. Crucial to the shape of this solution is not only the establishment of appropriate values, but also designing proper connections that would result in control over the most important nodes. Such a network is built gradually. Parties check if they agree on the facts. They

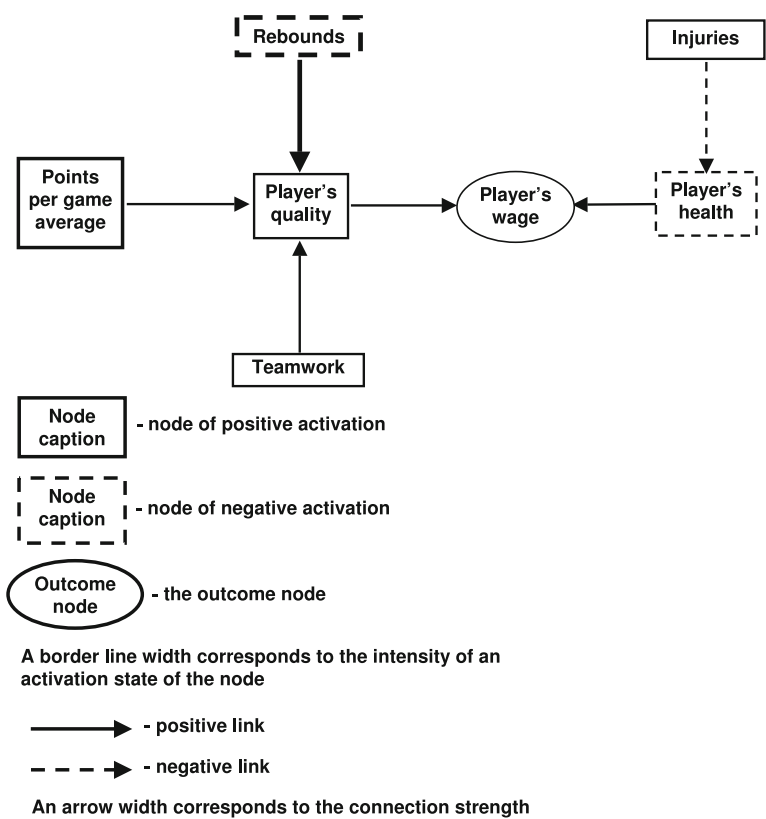


may do it actively, by explicit acquiescence, or passively, by lack of a protest. In case of disagreement, parties discuss the issue until reaching an agreement on the conflicting subject.

Each node is characterized by an activation value (activation level) (McClelland and Rumelhart 1987), which corresponds to the truthfulness, probability, certainty, intensiveness or value of a given statement, occurrence, fact, phenomenon or variable. The activation value may vary between  $-1$  and  $1$ . A negative activation value means that a fact, which is designated by the node, is false (or unlikely, improbable etc). A positive activation value means in turn that the fact is true (or likely, probable etc). An activation value close to zero stands for a level of truthfulness (or probability) that is unspecified. The high activation state of a node, according to information coded by this node, may indicate different meanings: high intensity of a phenomenon, high probability of an occurrence, high certainty (or probability) that a given statement is true. Similarly, an extreme negative activation state may indicate: very low intensity of a phenomenon, very low probability of an occurrence, high certainty (or probability) that a given statement is false.

Introduced issues are related to other issues. Such relations between facts are reflected by unidirectional links (sometimes called connections) that differ in their valence (positive or negative) and their strength. Unidirectionality of links means that if one node affects another node, the latter node may not necessarily affect the first one. For instance, it could be assumed that the better a basketball player is, the more money he earns. But the fact that the player earns more does not mean that he is a better player. Valence of a link may be either positive or negative. The positive link means that the first node is supporting the second node—the higher the activation of the first node, the higher the activation of the second node. The negative link means that the first node is negating the second node—the higher the activation of the first node, the lower the activation of the second node. Connections may differ in their strengths. The higher the connection strength, the stronger the impact of the first node on the second node (regardless of whether the connection is positive or negative). Similarly, in case of weak connection strength even big changes in the activation level of the first node would cause relatively small changes in the activation level of the second node.

To explain the DNN model, we will use a negotiation example, which will be showed on a network drawing (see Fig. 1). In this article, networks and parameters of their elements are presented on the pictures as follows: The border style of each node depicts its activation (solid line represents positive activation state, broken line—negative activation). Nodes are mainly represented in the form of rectangles, but nodes that represent terms of contract are drawn as ellipses (just to underscore elements of a contract in the structure of the shared reality; in the above example it is the “Player’s wage” node). The width of the border line of a node corresponds to the intensity of its activation state. The thinner the line, the closer to zero is the activation state of the node. The thicker the line, the more extreme is the activation state of the node (i.e., more negative in case of the solid line of an arrow and more positive in case of the broken line of an arrow). The direction of an arrow stands for the direction of influence (which element of the shared reality affects another). The style of an arrow means: solid—positive (+), strengthening connection; broken—negative (–),



**Fig. 1** Example of a network describing shared reality constructed during negotiations about the cost of a suitcase

suppressive connection. The connection strength is marked by the width of the arrow. The wider the arrow, the stronger the connection.

Let us imagine a negotiation between the president of a basketball club and the agent of a basketball player. They are bargaining over the wage of a prospective player of the club. The agent may mention the player's quality: *"He is a very good player because his average points scored per game is high."* In this way, the agent puts forward two nodes: "Player's quality" and "Points per game average" connected together by a positive link, which goes from the latter to the former node. The link means that the higher the average points scored by the player, the higher his quality. The player's quality positively influences his subsequent wage. Therefore, there is a positive link between nodes representing a player's wage and his quality. Let us imagine the president says: *"Yes, but this player gets almost no rebounds at all and we need a player that gets a lot of rebounds."* In this way, the president adds a node "Rebounds," whose activation is negative (because the player does not get enough rebounds) and which connects with a positive link to the "Player's quality" node. By mentioning that the club needs a player that gets many rebounds, the president increases the connection strength between the "Rebounds" node and the "Player's quality" node. In this way,

the previous node strongly affects the “Player’s quality” activation level. As a result, the activation of the latter node decreases, which means that the player’s quality is lower than what the agent says. The agent may in turn point out the player’s ability to encourage teamwork in every team he played with previously. In this way, he adds a node “Teamwork” that links to the “Player’s quality” and, as a result, increases its activation level. By contrast, the president may recall the number of the player’s injuries, which questions the player’s health and, as a consequence, is a reason for lowering the player’s wage. Thus, the president adds the nodes “Injuries” (positive activation level) and, negatively connected, “Player’s health” (negative activation level). The negative link between these nodes means that the more injuries the player has had, the lower (more negative) is the activation level of “Player’s health” and, as a result, the lower is the activation of the “Player’s wage” node. The final network of this example is presented in Fig. 1.

In summary, the model is based on the assumption that the process of constructing a shared reality in the course of negotiation may be represented as a process of constructing a network of nodes and connections between them. Nodes represent statements and connections represent relations between those statements. All the details discussed, expressed and stated during the negotiation process are meaningful for the shape of shared representation. In general, a simple model with few assumptions may describe the process and explain the outcome of even very complex negotiations.

### 1.6 Example of a Network Construction Process

The following example shows how the DNN is used to represent the development of a shared reality during the contract negotiation of a basketball player. This example is based on a role-playing simulation game that was recorded during a negotiation course. According to the scenario, this player is Polish. His name is Tripled and he studied in United States. He used to play in the NCAA basketball league, and came back after his studies to Poland, and now wants to take up work in one of the Polish first league clubs. Negotiations are conducted by his agent and by the manager of an imaginary first league club (Polon Warsaw).

Recordings of the talks were transcribed and used to construct the network with a competent judges procedure. First, every judge marked parts of the text that corresponded to nodes. Then, in the further processing only elements that were marked by both judges were considered. In the next phase, the judges extracted behaviors concerning establishing and changing links between nodes. In the following example, statements of the parties were written in italics. Names of nodes are put in-between quotation marks. The transcription parts are intertwined with sections that describe the process of appropriate network construction.

*Agent: I am the manager of Stan Tripled—a very promising player. This is my business card.*

*Manager: I have been asking for this meeting because our club is interested in purchasing your player. He is very young and lacks experience. We would like to negotiate the terms of the contract. Under what terms would he be playing in our club?*

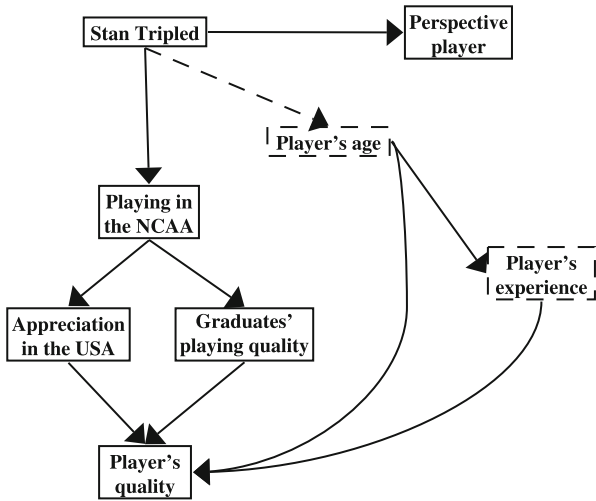


Fig. 2 Basketball player's salary negotiation. The initial state of the network

Agent: *Yes, of course. As you can see, he has been playing in the American Academic league. This league is, it is a well-known fact, the best basketball league, whose graduates start to play on the highest level. So, the fact that my player has graduated from this school is a guarantee of his playing level. Apart from that, he has been appreciated there and I hope that you are aware of his skill level.*

This conversation was translated into the network as follows (Fig. 2): First, the agent puts forward nodes: “Stan Tripled,” “Perspective player,” which are connected by a positive link. Then the Manager puts forward nodes: “Player’s age” and “Player’s experience”—both have a negative activation level. They are connected to the “Stan Tripled” node and “Player’s age” links positively to “Player’s experience.” States of negative activation mean that the player is young and inexperienced. The positive link from “Player’s age” to “Player’s experience” means that the younger the player the more inexperienced he is. Analogously, the older the player the more experienced he is. Subsequently, the agent puts forward the nodes “Playing in NCAA,” “Graduates’ playing quality,” “Appreciation in the USA,” and “Player’s quality”. “Appreciation in the USA” and “Graduates’ playing quality” are positively connected to “Playing in the NCAA.” They also positively link to “Player’s quality”. This way these two nodes cause positive activation of the “Player’s quality” node. On the other hand, “Player’s age” and “Player’s experience” is positively connected to “Player’s quality” as well, but both nodes have a negative activation level, so they induce a lowering of the “Player’s quality” activation. The current state of the network is presented in Fig. 2.

Manager: *Yes, but Tripled had some problems in the team or some difficulties in getting into the starting lineup (In basketball “starting lineup” means the first five players that start a game). I don’t know the exact reason, if it was the player’s emotional state or poor skills. He managed to play only after his older teammates left the team. So it might be the result of some problems.*













**Table 1** List of nodes of the network created on the basis of the basketball player's wage negotiation

No	Node name	In-degree	Out-degree	Betweenness
1	Stan tripled	0	5	0
2	Perspective player	1	0	0
3	Player's age	1	2	.0073085
4	Player's experience	3	3	.0304099
5	Playing in NCAA	1	4	.0040323
6	Graduates' playing quality	1	1	.0031082
7	Appreciation in the USA	1	1	.0031082
8	Player's quality	5	4	.0411626
9	Player's problems	3	1	.0030242
10	Player's psyche	0	1	0
11	Poor skills	0	1	0
12	Starting lineup	1	0	0
13	Teamwork	2	1	.0076445
14	Club quality	4	1	.0120968
15	First league experience	0	1	0
16	Players' experience	0	1	0
17	Quality of sporting facilities	0	1	0
18	Foreign players in the club	0	1	0
19	Opportunity	1	1	.0100806
20	Average league player's wage	4	1	.0120968
21	Player's wage	5	0	0
22	Affordable price	0	1	0
23	Player's foreignness	0	1	0
24	Professional playing	1	1	.0017641
25	Player's development possibilities	4	1	.0080645
26	Skillful	1	1	.0024362
27	Agent's data	0	1	0
28	International experience	1	1	.0014281
29	Playing with the best	1	2	.0014281
30	Better offer	0	1	0
31	Club lineup quality	1	1	.0100806
32	Championship	1	0	0
33	Sponsor	0	1	0

The first column—order of appearance of nodes; second column—in-degree coefficient; third column—out-degree coefficient; fourth column—betweenness coefficient

they are the arguments that directly concern the “outcome node(s).” *Interest nodes* are not particularly distinguished from other nodes, but they seem to serve a special role in the negotiation process compared to other nodes. Such nodes represent presumed interests of the parties engaged in the negotiation. Thus, a party may accept another node, because it substantiates the node representing the interest of this party. So the

interest nodes may serve to help accept other nodes that otherwise would be difficult to accept. In the above example, “Teamwork” is an interest node—it helps in accepting “Player’s quality” and “Player’s experience” activation levels. *Other nodes*’ role is to substantiate the activation levels of other nodes (high in-degree nodes) or to connect sub-parts of the networks together and in this way influence activation levels of the nodes that are part of other parts of a network. *Wasted nodes* are not really utilized in the network, but if the network had been built differently, they could serve an important role. One such node is “Player’s problem”, which is not important for the outcome, but if it had been somehow connected to the outcome node, then it might serve an important role in this negotiation.

Various nodes serve different roles in a negotiation, but only together do they form a complete structure that determines the outcome of the negotiation. One node may serve more than one role at the same time. For example, a node may have both high in-degree and high out-degree simultaneously. In other words, such a node would serve as a sink and as a source of information at once. Therefore, to understand an outcome of a negotiation, one has to focus on the structure of the network, not on the specific nodes, since the interrelation of many elements determines the outcome of the negotiation. To win a negotiation, a negotiator should introduce favorable source nodes, which are undeniable facts, but also create appropriate sinks and connect them by means of appropriate bridges to the network. Moreover, it may be important to have control over the direct influence nodes that may represent such notions as BATNA and, consequently, directly affect the outcome.

Although the nodes in the network constitute a certain structure and the position in this structure implies the importance of a given node, another important matter is how such a node is connected to the network. In the above negotiation, the “Sponsor” node was connected directly to the negotiated “Player’s wage.” It is possible, however, that this node could be successfully connected to the “Club quality” node, since having a good sponsor may imply the quality of a club. In this negotiation, the “Sponsor” node was connected to the “Player’s wage,” so it increased the wage. If the “Sponsor” node had been connected to the “Club quality,” it would have affected the “Player’s wage” negatively (through the “Club quality,” “Opportunity,” and “Player’s development possibilities”) and decreased its activation value. In fact, many nodes might be connected to the network in many different configurations and, in this way, affect the outcome differently. In the presented in this article experiment we examined this problem and showed that the outcome of the negotiation significantly varies depending on the final structure of the network.

## **2 Dynamics of Network Construction**

The process of network construction is an important factor in determining the outcome of a negotiation. The nodes created serve different roles according to their positions in the network. Similarly, the process of the negotiation contributes to the establishment of this kind of structure. Both the differences between negotiating parties and the preferences for achieving specific activations of certain nodes entail characteristic

dynamics of the network creation process. Parties start to construct a shared reality with the nodes that are distant from the “outcome node(s)” (i.e., the ones that represent the contract). In fact, the “outcome nodes” appear only after some time in the negotiation process. At the very beginning appear “source” nodes. In other words, parties start the negotiation with the obvious facts that are subsequently used to justify other elements of the shared reality. Relatively quickly appear nodes that have high in-degree (e.g., Player’s quality and Club quality). They are the elements that later influence the activation of the “outcome node”—Player’s wage. The nodes with high in-degree are the nodes that are important for the outcome and their activation is, at the beginning, not clearly specified—the parties would not bother to specify the already specified or unimportant nodes. So parties have to determine their activation levels before they take care of the “outcome node(s).” In this way, along with the appearance of the high in-degree nodes appear the nodes that support them. After establishing these two kinds of nodes (namely the nodes with high in-degree and the nodes attached to them) parties work on connecting the high in-degree nodes to the “outcome node(s).” This task is done by means of the bridges—the nodes which justify the relationship between sources and outcomes. In this way, bridges gain high in-betweenness. In parallel with this process appear “interest nodes”. Their role is to convince the other party that a specific activation of the high in-degree nodes is favorable. Therefore, the participants may achieve the desired activation of a node and later use the node to obtain a profitable activation of an “outcome node(s).” Finally, parties start the process of ultimate determination of the “outcome node(s).” Thus they link existing nodes in order to influence the “bridge” nodes and add the “direct influence nodes” that finally specify the activation of the “outcome node(s).”

A DNN is gradually being constructed. Parties start this process by establishing a set of quite specified nodes. On such a basis, by adding appropriate nodes step by step, they build a common network. Depending on what kind of nodes are used to construct the network, and what the activations of given nodes are, parties adjust the process of network construction. For example, a sink is developed as a result of initial disagreement about the activation level of this node. Since parties disagree about its activation level, they substantiate their point of view by adding new nodes that would ameliorate its activation level. In this way a node gains new incoming connections as long as its activation level is not ultimately agreed upon. Similarly, some other nodes may be used or not used depending on whether the activation level of a node with which they could be connected is advantageous. Therefore, the process of shared reality creation is important in determining the structure of the DNN, the activation levels of its nodes, and the final outcome of the negotiation.

## 2.1 Study

By focusing on the process rather than on the static elements, the DNN model explains the outcome of a negotiation more precisely than do traditional models of negotiation. Static models center mainly on the objective reality—not on the subjective perceptions of the negotiating parties. There are, however, some issues that make the prediction of



### 3.2 Participants

Participants were 36 female and 22 male freshmen from the University of Warsaw that took part in a summer camp group. Their age ranged from 18 to 22 years ( $M = 19.07$ ,  $SD=0.97$ ) for females and from 18 to 26 years for males ( $M = 19.68$ ,  $SD=1.61$ ). Participants received no financial reward for their participation.

### 3.3 Design and Procedure

The research was conducted at the end of an eight hour negotiation course. It was designed as a role playing simulation game. First, participants filled out simple questionnaires about demographic data. Then, each side received a unique scenario describing a negotiation situation. Next, parties negotiated. Their negotiations were recorded. After the negotiation, participants wrote down their agreements.

The design of the negotiation game was as follows. The negotiation scenarios concerned a matter of ashes that were by-products of the electricity production process in the coal electricity plant. Participants were divided into dyads: one person played the coal plant representative, whereas the other played the role of a cement plant representative. Parties were asked not to show or quote their scenarios to one another, but they were allowed to say anything they wanted in their own words. The scenario of the coal plant party reported that the coal plant must get rid of 50 tons of ashes and is ready to pay for a recycling process up to 50 units of money (Polish Zloty) per 1 ton. The scenario of the cement plant reported that this party wanted to buy up to 50 tons of ashes and was able to pay up to 50 units of money per one ton. The reason provided for this was that the ash is necessary material for production of high quality cement. Hence, both parties wanted to pay for the transaction of passing the ashes from one side to the other and neither party was aware that the other side was willing to pay. The scenario might seem odd, but they had been based on a real life situation that happened in Poland.

Since both parties were willing to pay 50 polish zloty per ton for the cement, the real zone of agreement was from  $-50$  (the electricity plant pays 50) to  $+50$  (the cement plant pays 50) per one ton. According to an objective negotiation situation, the distribution of results achieved in the study should be characterized by a normal distribution with the mean at the zero point (the electricity plant gives the ashes to the cement plant for free). According to the posed hypothesis, the shared reality constructed in the course of the negotiation should affect the outcome of the negotiation. We state that the variance of outcomes would be better explained by the created shared reality than by the objective conditions of the negotiation situation. In order to check this hypothesis, we analyzed the recordings and outcomes of the negotiations.

### 3.4 Measures

We measured the following variables:

1. Outcome of the negotiation—the amount of money for which parties agreed to trade the ashes.
2. Type of network structure of achieved shared reality:









The network analysis also helps us to understand why and how a given outcome has been achieved.

Elements introduced to the shared reality are uniformly agreed upon by participating parties and, in this way, they form a structure of common justification of the result of the negotiation. Thus, not only is what we talk about important, but also the structure of shared reality that results from our talk. Moreover, the new incoming elements cause changes in already existing elements of the shared reality, so the time pattern of the process of creation of the shared reality influences the result of the negotiation.

A network structure reveals roles of various elements that are important to the negotiation outcome. Depending on the place in the network structure, there are a few most important types of nodes: sources, sinks, and bridges. Sources represent acceptable facts that serve as a base for constructing the shared network. Sinks are the arguments, which are disputable, and are important for the outcome. Their importance is, however, dependent on connecting them to the outcome nodes by means of the bridge nodes. The bridges justify the relevance of the sinks to the outcome of the negotiation. In this way, on the basis of the DNN model, it is possible to understand the importance of various elements of the shared reality for the outcome of the negotiation.

The differences between negotiating parties in perceiving the negotiation situation and their different preferences for achieving specific outcomes entail characteristic dynamics of the network creation process. First appear the source nodes, since they are later used to justify other elements of the shared reality. Relatively quickly, parties start to formulate their main arguments and start struggling over their justification. In this way these arguments become *sinks*. The more important and more controversial the *sink*, the more time parties devote to agreeing on the activation of such a node. In consequence, the most important and disputable nodes achieve the highest in-degree coefficient. Finally, the outcome of the negotiation is specified by adding the “direct influence nodes” and connecting the sinks to the outcome nodes by means of the *bridges*.

Unquestionably, the objective structure of a negotiation situation is a crucial factor for determining negotiation outcomes. Yet, the objective structure may determine the outcome only up to certain point—there is always a place for negotiation. The objective reality influences perceptions of the negotiating parties and, in this way, constitutes a starting point for developing a shared reality. Part of the negotiation game is to change the perception of an opponent by appropriately changing the negotiation situation and / or imposing an appropriately shared reality so that one could find oneself in an advantageous position. In fact, the DNN model seems to be very suitable for depicting changes in the objective structure of a negotiation situation.

The achieved shared reality determines the outcome of the negotiation. The DNN model translates the process of creating a shared reality during a negotiation into the process of network construction. Hence, all the elements of a negotiation reality that are embedded in the shared reality and influence the outcome of the negotiation are embedded in the DNN. In this way, the shared understanding of the problem by the parties is reflected in the network structure and the network explains the outcome of the negotiation, though this understanding may differ when other parties negotiate with the same objective data. Although the objective conditions of the negotiation situation quite properly suggest the expected outcomes, the analysis of the



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