

# The Time Course of Language Use in Multiparty Negotiations

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## Abstract

Language use is an important part of a negotiation. Prior research has shown that similarity in language use is conducive to reaching agreements. This paper uses Latent Semantic Analysis to explore how the similarity of language use develops and changes over the time course of a three-party negotiation. Results support theories that suggest that a gradual alignment of semantic representation increases the likelihood that parties will form a coalition.

**Keywords:** Negotiation, Coalition Formation, Linguistic Entrainment, Psycholinguistics, Latent Semantic Analysis.

## Introduction

The language used by parties in a negotiation is a crucial aspect of their negotiation strategy and can greatly affect the outcome of the negotiation. Research over the past few decades has demonstrated that an agreement in a negotiation is often preceded by convergence in language use among the negotiating parties (cf. Miller, 2005). In the context of multi-party negotiation, such convergence is evident between the parties that reach an agreement, but not the excluded parties (Huffaker, Swaab, and Diermeier, 2011).

In this paper we extend the results of Huffaker et al. by analyzing the similarity of adjacent conversation moves. This type of analysis enables us to look at the time course of coalition formation and not just at the overall similarity of language use between participants.

Multi-party negotiation is naturally more complex than that a two-party negotiation (Bazerman et al., 2000). This is especially true since an agreement can be reached among a subset of the negotiating parties. Therefore being excluded from an agreement is a real possibility. Nevertheless, partial coalition agreements are often less desirable than agreements that involve the group as a whole because they are less efficient or do not use all of the available resources. However, even being part of a partial agreement is more preferable than no agreement at all or of being excluded from an agreement reached by others.

The added complexity of multi-party negotiation has been shown to affect the patterns of language use in such negotiations. Following the framework of Communication Accommodation Theory (CAT; cf. Giles et al., 2007), Huffaker et al. (2011) demonstrates how the formation of coalition is affected by specific aspects of language use by the negotiating parties. Specifically, they find that partners to a coalition show more similarity in language use than

participants who were not part of a coalition. The use of assents was also found to correlate positively with being a part of the coalition agreement. In contrast, the use of negative emotion words was a detrimental predictor to being a part of a coalition.

These results are congruent with empirical findings in psycholinguistics that show that in successful dialogues the representations and language used by dialogue partners tend to converge over time (e.g., Brennan and Clark, 1996). However, while Huffaker et al. show that similarity in language use is a factor in the outcome of the negotiation, they use the entire negotiation as the unit of analysis. Consequently, their results do not explore the time course of this similarity. This paper aims to extend their results by looking at whether the language used by the participants changes over time.

On the one hand, theories of entrainment and alignment in language use by dialogue participants, such as that put forth by Pickering and Garrod (2004), argue that language similarity is the result of gradual alignment of language use by the participants in the negotiation. The better the alignment the more likely the aligned parties would be to form a coalition. Such theories would lead to the prediction that language similarity should increase over the course of the negotiation and ultimately result in the parties forming a coalition.

In contrast, Swaab et al. (2011) shows that language mimicry during a negotiation is a factor in the outcome of the negotiation, but only when it occurred early in the negotiation. Therefore, we might expect that early similarity in language use might lead to the forming of a coalition later on.

It is also possible that both of these factors contribute to the effect that similarity in language use has on the resulting coalition. If that is the case we would expect to find not only that eventual coalition partners show more similar language early on than non-coalition partners, but that this difference increases over time.

## Measuring similarity in language use

Convergence of language use in a dialogue or negotiation has traditionally been measured by hand coding the transcripts of negotiation dialogue. Such hand coding is time consuming and, to a certain degree, requires the coders to interpret the language used by the negotiators. In contrast, the metric we use in this paper is automatically derived by

using the Latent Semantic Analysis cosine similarity of a pair of utterances. Such a measure has been used in the past as a measure of textual coherence (Foltz, Kintsch, and Landauer, 1998) and as a measure of linguistic entrainment (Huffaker et al., 2006).

LSA vectors for individual words are generated based on the co-occurrence patterns of words in large corpora. These vectors identify points in a high-dimensional space (100 dimensions in this case). The more likely two words are to co-occur with similar words the closer they will be in the space. For example, the vectors for *sun* and *moon* are fairly close together and show a cosine similarity of .53 whereas *man* and *moon* are not very similar and show a cosine similarity of .03. Moreover, when several word vectors from a single utterance are combined together, as was done in this study, the result identifies a point in space that represents the overall topic of the utterance.

It is important to note that this kind of automatic measure ignores certain linguistic elements that a coder might use. For instance, the use of negation is generally ignored, while sarcasm and metaphors are often misrepresented. However, since we are interested in the convergence of language use – that is, whether participants are using similar language to convey their (sometimes opposing) ideas, this type of analysis seems appropriate.

## Method

### Huffaker et al. (2011)

The data used in this paper comes from a study reported by Huffaker et al. (2011). They patterned their study after a pure coalition game outlined by Raiffa (1982). In that study, 180 MBA students were divided into 60 three-person groups. Within each group, participants were assigned to one of three roles (A, B, C) and instructed that they were to use an online chat room to negotiate a split of that payoff amongst themselves. Participants were unaware of the identities of the other participants in the negotiation.

Table 1: Payoff Table in the Negotiation Game from Huffaker et al. (2011)

Possible Agreements	Total Payoff
A alone	\$0
B alone	\$0
C alone	\$0
A and B	\$118,000
A and C	\$84,000
B and C	\$50,000
A, B, and C	\$121,000

Note: A, B, and C represent the participants in the negotiation. The payoff is split between the parties that reach the described final agreement.

All participants were provided with the payoff table in advance of the negotiation (see Table 1). As is evident from the table, different coalition formations receive different

payoffs, and if no coalition is formed no participant receives any payoff. The participants were allowed to negotiate how the payoff is distributed between them. These payoff options provide incentives for the participants to join up with another participant so that they can take advantage of the resulting weak bargaining position of the third participant. However, the payoff table is designed so that the third player can always make an attractive offer to one of the members of the initial coalition to induce a defection from the preliminary agreement. Consequently, participants are incentivized not only to be a part of a forming coalition, but also to ensure that it is a stable coalition and that their partner(s) will not defect.

Participants in the experiment were placed at computers in different rooms so that their only means of communication with each other was through the provided chat software. They logged into a public chat room to begin the negotiation process.

The software also allowed participants to move from the public chat room to three private chat rooms. That is, participant A could move into one of the private chat rooms together with participant B so that they could negotiate without participant C being privy to the content of the negotiation. However, all participants were alerted whenever a participant entered or exited a chat room so that the excluded participant was always aware that the two other participants might be negotiating in private. This mimics some of the real-world aspects of a negotiation, where parties are often able to communicate in private, but the fact that they communicated in private is common knowledge. A private exchange of information can also provide an indication that the two parties are forming a coalition.

### Semantic Analysis

The analysis in this paper is based on the transcripts of these negotiations. An LSA vector was computed for each individual utterance by using vector addition to combine the vectors of all of the content-bearing words in the utterance. When an utterance did not include any content-bearing words, a null vector was used to represent it. The vector space used for this analysis was generated by Infomap (<http://infomap-nlp.sourceforge.net/>; Schütze, 1997) using the written part of the British National Corpus.

Next, the correlation of the vectors representing temporally adjacent utterances was computed<sup>1</sup>. These correlations were not computed when one of the utterances had a null vector or when the two utterances did not occur in the same chat context (i.e., when they occurred in different chat rooms).

In some cases identical vectors represented adjacent entries. These were generally the result of statements such as “I agree” or “X is present” and were found either at the

<sup>1</sup> Because the first dimension of LSA vector spaces tends to correlate with the frequency and length of the text it was dropped from the analysis (cf. Hu et al., 2007)

very beginning or the very end of the negotiation. They were dropped from the analysis because they did not appear to represent a meaningful part of the negotiation. That is, they did not represent linguistic convergence between participants but rather formulaic utterances that occurred mostly before the negotiation started or after it has concluded. Regardless, the results presented here are quantitatively and qualitatively similar whether these data points are included or excluded.

In order to test for convergence in language use we categorized the utterance pairs based on the two participants that contributed to them. We predicted that participants who were included in the resulting agreement would have more similar language use than those who included a participant who were excluded from the agreement. For example, if an AB agreement was reached, utterance pairs between A and B would be predicted to have more similar language use (i.e., utterance-to-utterance correlation) than those between A and C or B and C. Consequently, we divided the utterance pairs to those in which both participants were included in the final coalition (*successful utterances*) and those in which at one of the participants was excluded from the coalition (*unsuccessful utterances*). Importantly, when the final agreement included all parties, all of the utterance pairs were considered to be successful. In contrast, when no agreement was reached all of the utterances were considered to be unsuccessful.

Because the parties are unfamiliar to each other when they enter the negotiation we also expected that this difference would emerge over the course of the negotiation and become apparent only once a coalition begins to form. Therefore, we divided the utterance pairs based on their position in the negotiation<sup>2</sup> – If the first utterance of the pair occurred in the initial half of the negotiation it was classified as an *early utterance* whereas utterances that occurred in the second half of the negotiation were considered *late utterances*.

## Results

As mentioned above, we derived two distinct hypotheses:

1. Following accounts of linguistic entrainment (e.g., Pickering and Garrod, 2004), we hypothesized that coalition formation will be accompanied by the alignment of language use. Consequently, if linguistic entrainment occurs as part of the formation of a coalition, successful utterances should become more similar to their responses than unsuccessful

<sup>2</sup> For the purposes of this analysis we use a coarse grain division of time (halves) because some of the discussions consist of relatively few utterances (under 50). This is adequate for the purpose of our basic hypotheses, but does not provide a good sense of how the utterance-to-utterance similarity changes over time. It is possible to utilize smaller time units in an analysis of this type to gain further insight into the temporal progression of the negotiation (e.g. Figure 2). Essentially, the choice of temporal units for analysis represents a tradeoff between precision and statistical power.

utterances would be to their responses late in the negotiation. This will result in a significant interaction between the type of utterance and its position in the negotiation.

2. Following the literature on the effectiveness of mimicry in negotiations (e.g., Swaab, et al. 2011), we hypothesized that early mimicry would result in a higher likelihood of eventual success in the negotiation. Therefore, if mimicry is an effective tool in these negotiations, successful utterances should be more similar to their responses than unsuccessful ones early in the negotiation.

To test these hypotheses we conducted a 2x2 ANOVA. The type of utterance (*successful vs. unsuccessful*) and its position in the negotiation (*early utterance vs. late utterance*) were the independent variables. The dependent measure was the average utterance-to-utterance correlation for utterance pairs conforming to the condition within a particular session. The means for each of the conditions can be seen in Figure 1.

There was no significant difference in similarity of language use between *early utterances* ( $M=0.15$ ,  $SD=0.08$ ) and *late utterances* ( $M=0.14$ ,  $SD=0.09$ ) ( $F(1, 186)<1$ , *n.s.*). There was a slight trend where *successful utterances* ( $M=0.15$ ,  $SD=0.08$ ) showed more similar language use than *unsuccessful utterances* ( $M=0.13$ ,  $SD=0.09$ ) ( $F(1, 186)=2.86$ ,  $MSE=0.01$ ,  $p=0.093$ ).

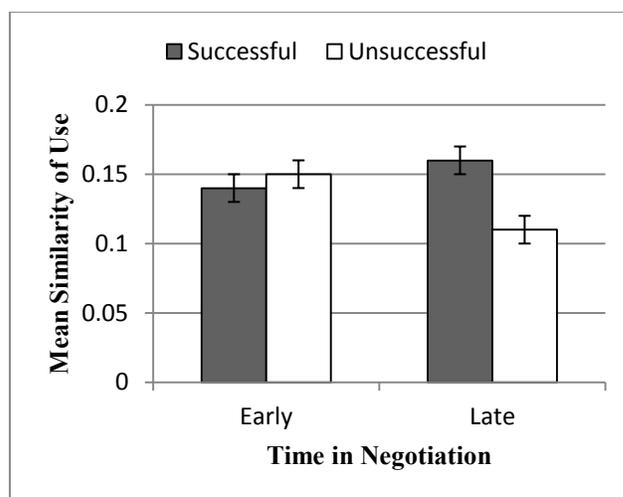


Figure 1: Similarity of Language use by utterance pair type and position in the negotiation. Error bars represent standard error.

More importantly, the interaction between utterance pair type and position was significant – The difference in language use between *successful* and *unsuccessful* utterances was greater for *late utterances* than *early utterances* ( $F(1, 186)=7.15$ ,  $MSE=0.01$ ,  $p<.01$ ). Furthermore, Tukey HSD tests identified a significant

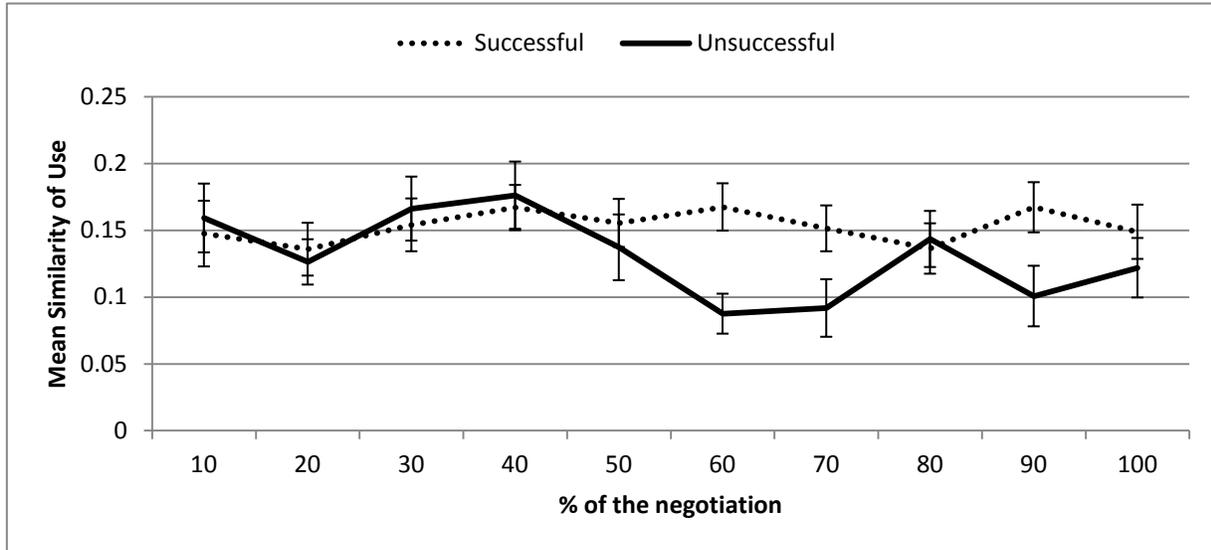


Figure 2: Mean similarity of language use by utterance pair type over the course of the negotiations. Each time period corresponds to 10% of the negotiation (calculated individually for each negotiation). Error bars represent standard error.

difference between *late successful utterances* ( $M=0.16$ ,  $SD=0.08$ ) and *late unsuccessful utterances* ( $M=0.11$ ,  $SD=0.09$ ) ( $D=0.051$ ,  $p<.01$ ) but not between *early successful utterances* ( $M=0.14$ ,  $SD=0.07$ ) and *early unsuccessful utterances* ( $M=0.15$ ,  $SD=0.10$ ) ( $D=-0.01$ ,  $n.s.$ ). This result provides support for accounts in which a gradual alignment in language use and semantic representation leads to a likelihood of forming a coalition (Hypothesis 1). However, we found no support for accounts in which early similarity in language use (e.g., mimicry) leads to the formation of a coalition (Hypothesis 2).

Interestingly, while there appears to be a slight increase in the utterance-to-utterance similarity of successful utterance pairs from the first half to the second half of the negotiation, the observed interaction seems to be driven more by an unexpected *decrease* in the utterance-to-utterance similarity of unsuccessful utterances.

It might be possible to shed some light on this unexpected result by examining how the similarity of language use unfolds (Figure 2). A qualitative examination of the trends shows some evidence for early alignments of language use between the first 20% of the negotiation and the next 20% among all parties. However, the striking difference between the successful and unsuccessful utterance pairs is most evident starting around the 60% point of the negotiation, on average. At this point there is a sharp drop in the similarity in language use of unsuccessful utterances. It appears that at that time period in the negotiation the coalitions are starting to form or have already formed (see Table 2 for sample of successful and unsuccessful utterances from that time period).

Table 2: Sample utterances from the 60% slice of the negotiation (each utterance is from a different session)

Successful Utterances	
1	Do you still agree on our terms?
2	So lets talk about the split.
3	We can partner 3 ways and give them 3k
4	I presume you would rather do 72/28, right?
5	Can we say 69 to A, 48 to B and 4 to C to get a deal
Unsuccessful Utterances	
1	Too late, we already agreed, its over, take it like a man
2	50/50 I lose out. John will give me 58/26
3	Though you have all the power, you need either one of us
4	27/3 doesn't sound reasonable
5	Just don't steal my shoes.

## Discussion

The analysis presented here, based on data collected by Huffaker et al. (2010), supports the hypothesis that the gradual alignment in language use is a contributing factor in reaching an agreement over the course of a negotiation. Participants in the study that were part of the final coalition showed more similar language use in the second half of the experiment than participants that were not part of the final coalition.

Interestingly, while the predicted interaction was found, the observed effect was somewhat different than expected. It appears that the major shift in language use leading to, or immediately following, the formation of a coalition is more likely to be a reduction in the utterance-to-utterance similarity for the excluded parties rather than an increase among the included parties. The causes for this require further study, but it seems possible that this is due to a change in the pattern of language use that the excluded party is not a part of. For instance, after agreeing to form a coalition, the parties might shift to discussing how to split the payoff while the excluded party might still attempt to convince one of the other participants to join a coalition.

The results of this paper seem to suggest that multi-party negotiations, while more complex than two-party negotiations and dialogues, follow many of the same patterns as their simpler counterparts. However, the added dynamics of such a negotiation also allows researchers to examine topics that are often difficult to explore when only two parties are involved in a linguistic exchange. In this case, it appears that when a party to the conversation or negotiation is “left behind”, it might also fall out of linguistic alignment with the other participants.

Nevertheless, there is much room left for further analysis. While the initial analysis reported here provides some promising results, it is not conclusive. Furthermore, it opens the door for additional questions. For instance, it is possible that a 2-party coalition would be more likely to form during a private exchange rather than a public one. However, because of the relatively short length of some of the negotiations (under 50 utterances divided among the three parties), we elected not to separate the discussions based on whether they were part of a public exchange or a private one.

Another possible avenue for future investigation is to explore whether the patterns of linguistic entrainment differ based on the emerging final coalition. For instance, would a final 3-party coalition show a pattern consistent with a particular 2-party coalition up to some point at which the final participant in the negotiation also joins in? This is an interesting, if complicated, question that we leave open for future research.

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