1 Introduction

Conversations often involve an element of planning and calculation of how best one can achieve one’s interests. We are interested in how conversations proceed in a setting in which the interests of the dialogue agents are opposed. While most efforts on conversation in linguistics and in AI have concentrated on conversation stemming from (Grice, 1975)’s analysis of conversation in terms of the establishment of mutual intentions, we are convinced that the study of conversation in non-cooperative conversation, conversation in which mutual or common intentions are not present, will also yield valuable insights and increase our linguistic understanding of dialogue.

Our goal here is to explore some linguistic ramifications of a particular formal model of strategic conversation, put forth in (Asher and Paul, 2012; Asher and Paul, 2013). In particular, we study a form of incomplete information that most frameworks do not address, one where one strategic player is unaware of moves that another player may perform. To study this form of incompleteness, we use a formal theory that is quite different from other extant work. For instance, (Asher and Lascarides, 2013) provide a model based on signaling games to explore agents’ commitments to explicit and implicated content in non-cooperative conversations; they show the Gricean model to be a special case of a more general theory. Our model uses a kind of game from descriptive set theory and formal system verification in computer science known as Banach Mazur games. Banach Mazur games are very different from signaling games. The work of (Traum and Allen, 1994) has also explored dialogues where non cooperative frameworks with interesting analyses of persuasions and negotiations (Traum et al., 2008; Traum, 2008); but there is no formal analysis of the structure of conversations, which is what the framework we use provides. Our goal in this paper is to introduce BM games framework to the linguistic community, concentrating on the particular form of incomplete information mentioned above.

Here are some motivating intuitions. Consider a situation in which two political candidates are engaged in a debate. Each candidate has a certain number of points he wants to convey to the audience; and each wants to promote her own position to the expense of the other’s. To achieve these goals each participant needs to plan for anticipated responses from the other. Debates are thus games; an agent may win lose or draw. Similar strategic reasoning about what one says is a staple of board room or faculty meetings, bargaining sessions, and even conversations with one’s children. Many such conversations have a determinate outcome. One dialogue agent can “win” if she can play certain conversational moves; and if she doesn’t, she loses. There is also a strong intuition that in many conversations some conversational strategies, and some winning conditions, are much more complex than others.

(Asher and Paul, 2012) demonstrate a compelling similarity between human conversations and Banach-Mazur games, which capture our intuitions. They show how various conversational objectives correspond to various levels of what is known as the Borel hierarchy (which we introduce more fully below) and how strategies of increasing complexity are called for to attain such objectives. (Asher and Paul, 2013) further that framework and show that when Player 0 does not know what Player 1 might do, it might be wise for her to strategise at a higher level to account for this uncertainty. In particular, Player 0 has incomplete knowledge about the moves of Player 1.

A linguistic example of this is the memorable line by Senator Lloyd Bentsen in his Vice-Presidential debate with Dan Quale in 1988. Quayle’s strategy in the debate was to counter
the perception that he was politically too inexpe-
rienced to have the job. Given that Quayle was
a very junior and politically inexperienced Vice-
Presidential candidate, he was repeatedly ques-
tioned about his experience and his qualifications
to be President, should the need arise for him to
step into that position. Quayle thought he had
a winning strategy to rebut the doubts about his
qualifications by comparing his experience and
qualifications with those of John Kennedy’s be-
fore the 1960 U.S. presidential election. Quayle
seemed to have achieved his winning condition of
being every bit as fit to be president as the great
John Kennedy. Here is the relevant portion of
the transcript of that debate:

(1)  Tom Brokaw: Senator Quayle, I don’t
mean to beat this drum until it has no
more sound in it. But to follow up on
Brit Hume’s question, when you said that
it was a hypothetical situation, it is, sir, af-
ter all, the reason that we’re here tonight,
because you are running not just for Vice
President (Applause) and if you cite
the experience that you had in Congress,
surely you must have some plan in mind
about what you would do if it fell to you
to become President of the United States,
as it has to so many Vice Presidents just
in the last 25 years or so.

(1b)  Quayle: Let me try to answer the question
one more time. I think this is the fourth
time that I’ve had this question.

(1c)  Brokaw: The third time.

(1d)  Quayle: Three times that I’ve had this
question and I will try to answer it again
for you, as clearly as I can, because the
question you’re asking is, "What kind of
qualifications does Dan Quayle have to be
president," "What kind of qualifications
do I have," and "What would I do in this
kind of a situation?" And what would I do
in this situation? [...] I have far more ex-
perience than many others that sought the
office of vice president of this country. I
have as much experience in the Congress
as Jack Kennedy did when he sought the
presidency. I will be prepared to deal with
the people in the Bush administration, if
that unfortunate event would ever occur.

(1e)  Judy Woodruff: Senator [Bentsen]?

(1e)  Senator, I served with Jack Kennedy. I
knew Jack Kennedy. Jack Kennedy was
a friend of mine. Senator, you’re no Jack
Kennedy.

Quayle’s strategy at that point fell apart. He had
no effective come back and by all accounts lost
the debate handily. It seems that he was clearly
unprepared for Bentsen’s move.

As a case study to illustrate the framework we
describe, we will show exactly how Quayle got
ambushed and why.

2  Preliminaries

Formal models of textual meaning using dynamic
semantics with rhetorically structured discourse
contexts are now well developed and have been
used in the analysis of dialogue. Building on (Las-
carides and Asher, 2009), (Asher and Lascarides,
2013) extend signaling games to gauge what im-
plicatures can be taken as part of the conversa-
tional commitments of speakers. Here we take the
content of the message is fixed assuming (Asher
and Lascarides, 2013). So signaling games will
play no role here.

As we can see from the exchange in the debate
in (1), the goal of a strategic conversation or per-
haps a part of it as in this example, often has to
do not only with the moves of one conversational
agent, but with those of the other agents as well.
That is, in order for (1d) to succeed, it must answer
the question in (1a) to the satisfaction of the oppo-
nent. Ideally, what the follow-up to Quayle’s reply
in (1d) should have been was silence from Senator
Bentsen and a Thank you senator for that response
from the moderator. Thus, a win in a conversa-
tion has often to do not so much with an end state
or with a particular move of one dialogue agent
but with a sequence of moves by several dialogue
agents. We want to characterize such sequences in
an abstract and formal way.

One attempt at characterizing message ex-
change is to use a trust game (McCabe et al.,
2003), a formal model of two or more agents send-
ing goods to one another. A trust game depicts a
scenario where Player X has an initial option to de-
fer (A) to Player Y for a potentially larger payoff
(C) for both. Player Y could defect (D) on Player
X and keep more money for himself. The game is
asymmetric in that the first agent places his fate in
the hands of the second. The game looks in extensive form looks like this:

\[
\begin{array}{c|c|c|c|c|c}
&A & D & H \\
\hline
X & 0,0 & -1,2 & 1,1 \\
\hline
Y & -1,2 & 0,0 & 1,1 \\
\end{array}
\]

The utilities assigned to the nodes look like this:

\[
U_x(AD) < U_x(\neg A) < U_x(HA)
\]

\[
U_y(AD) > U_y(HA) > U_y(\neg A)
\]

For a one-shot game, deference will not occur for a rational Player X.

How does this game apply to conversation? (Asher and Quinley, 2011) argue that speakers are in the position of X in the trust games above. When they make a request, ask a question or even make an assertion, they open themselves to attacks on their “face” (Brown and Levinson, 1978). It may be in Y’s interest to defect and not talk to X, especially if their communicative goals or otherwise are incompatible.

The immediate question to ask given this model of message exchange is, why do people answer questions even when it’s not in their interest to do so? There are various answers and they can be modeled in different ways. One is that Y’s reputation may be affected by Y’s response. Technically, however, there are problems. Suppose we attempt to capture reputation by repeating the trust game above. This alone won’t work: even in an extended or repeated trust game that is finite with determinate end states, agents can use backwards induction so that they defect at the initial exchange. And so we have the uncomfortable result:

**Proposition 1** In an extended trust game consisting of a sequence of trust games, deference will not occur for a rational player X.

To make get a different result, we have to assume the utility function has a certain character so that later trust games will affect the utility function in earlier trust games. But then still we should predict that as the conversation nears its end that strategic conversations should break down.

The empirical facts are, we are convinced, that conversational agents with opposing interests more often than not continue to respond to each other’s requests for information. Even in single linguistic exchanges, players do not defect in general. Consider the following two cases, discussed in (Asher and Lascarides, 2013), where Bronston is on trial for bank fraud and Janet is being questioned by her jealous and suspicious boyfriend Justin:

(2) a. Prosecutor: Do you have any bank accounts in Swiss banks, Mr. Bronston?
   b. Bronston: No, sir.
   c. Prosecutor: Have you ever?
   d. Bronston: The company had an account there for about six months, in Zurich.

(3) a. Justin: Have you been seeing Valentino this past week?
   b. Janet: Valentino has mononucleosis.

As background, assume that Bronston in fact had a Swiss bank account, which he wants to conceal because the account was the recipient of illicit funds and that Janet has in fact seen Valentino. One could plausibly argue that it is in neither Bronston’s nor Janet’s interest to respond to the question. Nevertheless, both Bronston and Janet respond to the questions asked of them. They don’t refuse; they don’t defect.

We believe that a better way to understand this is to think of this small exchange as embedded in a larger game with no intrinsic end points. It is not that the game is in fact repeated; it continues, but prior moves can affect later ones. So if Y defects now, she may very well suffer as the conversation continues. This doesn’t mean that conversations don’t end; it means just that players cannot predict when they will end. To model such conversations, we take them to be infinite sequences; and so as (Asher and Paul, 2012) argue, an appropriate framework is some type of infinite game. To model a conversation that ends, we may as is usual in this domain choose a special action $\Box$ that has an infinitary null continuation.

There are a variety of infinite games that have been studied in descriptive set theory—Banach Mazur, Gale-Stewart, Wadge, and Lipschitz games (Kechris, 1995). They have been used
in topology and in the formal verification of reactive systems in computer science. (Asher and Paul, 2012) opt for a framework in which players may have several moves at each turn, which corresponds to observed facts on dialogue annotated corpora (Afantenos et al., 2012b). This leads them to take Banach Mazur games as a framework for the analysis of strategic conversations. Here are its characteristics:

- 2 players each play a finite sequence of moves from a fixed set \( A \)
- Players alternate indefinitely, building strings in \( A^\omega \)
- A BM game contains a winning condition for player 0 \( \text{Win} \subseteq A^\omega \).

The set of infinite strings forms a metrisable topological space and so we can characterize various winning conditions in terms of basic open sets, unions of basic open sets, unions of basic open sets which defines the \( \Sigma_1^0 \) level of the Borel hierarchy, complements of unions of basic open sets (the \( \Pi_1^0 \) sets of the Borel hierarchy), countable unions of \( \Pi_1^0 \) sets (the \( \Sigma_2^0 \) Borel sets) and so on. This gives rise to a complexity hierarchy known as the Borel hierarchy.

Now how do we adapt this to dialogue? Here we make use of linguistics and of theories of discourse structure, for instance SDRT(Asher and Lascarides, 2003).

- The alphabet \( A \): basic discourse moves as given by SDRT—EDUs, discourse relations between EDUs, CDUs, discourse relations between CDUs and EDUs all form elements of our alphabet.
- Each SDRS is a finite sequence of elements from \( A \).
- The elements of the topological space are infinite strings over \( A \). These are all the possible conversations using this alphabet.

Thus formally,

**Definition 1** The set of conversations is a BM game \( BM(A^\omega, \text{Win}) \) where \( \text{Win} \subseteq A^\omega \) and \( A \) is a countable set of basic moves as described above.

A player, at turn \( i \), picks a finite sequence \( x_i \) of such moves, with \( x_i \in A^* \). At any point in the conversation, these finite sequences of moves concatenate and give us a finite conversational play \( x \). Given a finite conversational play \( x \), what the players can still say, or how the conversation can continue, is represented by all the infinite sequences that continue \( x \), i.e. \( xA^\omega \). \( B(A) = \{ xA^\omega : x \in A^* \} \) are our basic open sets. The set of open sets in \( A^\omega \) correspond to all the possible ways a conversation can go from a particular point.

For instance suppose the sequence in (1) and that Player 2 responds either with (21) or (22):

(4) P: I’m interested in whether you, Mr. Bronston, ever had a bank account, (f) not about your company (g) Please answer the question.

(5) P: Thank you, Mr. Bronston (f') I now would like to move to the question of your involvement in the Victory offshore trading company located in the Bahamas. (g') Were you an officer of this company or not?

\( O(1 \ast 4) \cup O(1 \ast 5) \) is the set of all continuations of the two possible sequences.

(Asher and Paul, 2012) show how various conversational objectives correspond to various levels of what is known as the Borel hierarchy and how strategies of increasing complexity are called for to attain such objectives through a number of simple Borel sets and give examples of conversations whose intuitive victory conditions are characterized by a particular degree of Borel complexity. For instance, Bronston plausibly has a \( \Pi_1 \) winning condition, of avoiding any moves in which he would incriminate himself, while the prosecutor has a \( \Sigma_1 \) winning condition of getting Bronston either to admit that he had a bank account in Switzerland or to assert that he never had such an account.

Winning conditions in conversation can involve a combination of moves by the players. To achieve a winning objective say in Quayle’s case of looking qualified to the audience, it is not enough simply for Quayle to assert (1d); the other participants have to react to this move in a particular way. One or two may object, but the response by all the participants must be such that (1d) must be taken to be a satisfactory answer to the question in (1a). Thus, as we would expect in a BM game, a winning condition is typically a property of the conversational string as a whole or at least a subsequence of it.
We are thus interested how BM game play may effect the states of a system (or a conversation). It seems reasonable to observe that even though one may say anything at any stage of a conversation or send any message at a given state in a reactive system, not all messages have the same effect; that is, not all messages lead to distinct states in a graph of states of the system. In addition, sometimes two messages may have the same effect at a given state; sometimes a message at one state may have a different effect from what it has at another. We thus want to investigate in at least a preliminary way a correspondence between a play of messages in a BM game and a sequence of possibly more abstract states. To this end, let $X^\omega$ be the set of infinite strings in a BM game and let $(V, v_0, \rightarrow)$ be a graph, where $V$ is the set of vertices or states, $v_0$ being a distinguished start state, and $\rightarrow$ is a transition function $\rightarrow: V \rightarrow V$. Define a function $r: X^\omega \rightarrow V^\omega$ as follows:

- $r(\varepsilon) = v_0$

- For $u \in X^*$ and $a \in X$, if $r(u) = v_0 v_1 \ldots v_k$, then $r(ua) = v_0 \ldots v_k u v_{k+1}$, where $v_k \rightarrow v_{k+1}$

We will divide $V$ into states that are controlled by one player or another in what follows.

(Asher and Paul, 2013) investigate a particular form of incomplete knowledge about games that is pertinent here. They investigate a situation where the players are playing with different vocabularies or discourse moves, more particularly where one player plays with a strict subset of the vocabulary of the other. This represents a situation in which one player is uncertain or even unaware of the moves the other player may play. They prove a theorem which shows that this sort of incomplete information has an effect on how the winning conditions of the player with the smaller vocabulary are characterized in the Borel hierarchy.

**Theorem 1** Let $A$ and $B$ be two alphabets such that $A \subseteq B$. We have the following in the Borel hierarchy:

1. For $1 \leq \alpha < \omega$ and $\alpha$ odd,
   
   (a) a set $X \in \Sigma^0_\alpha$ in the space $A^\omega$ remains $\Sigma^0_\alpha$ in the space $B^\omega$
   
   (b) a set $X \in \Pi^0_\alpha$ in the space $A^\omega$ jumps to $\Pi^0_{\alpha+1}$ in the space $B^\omega$.

2. For $1 \leq \alpha < \omega$ and $\alpha$ even,

   (a) a set $X \in \Sigma^0_\alpha$ in the space $A^\omega$ remains $\Sigma^0_\alpha$ in the space $B^\omega$

3. For $\alpha \geq \omega$, a $\Sigma^0_\alpha$ (resp. $\Pi^0_\alpha$) set remains $\Sigma^0_\alpha$ (resp. $\Pi^0_\alpha$) on going from the space $A^\omega$ to $B^\omega$. That is, the sets stabilise.

For a proof see Asher & Paul, 2013.

The above result for the finite Borel hierarchy is summarised by Figure 1.

![Figure 1: Jumps in the Borel hierarchy](image)

### 3 Discussion

Let’s now consider strategic conversations in relation to the result we just described. From the point of view of Player 0, if she is playing a Banach-Mazur game where she is unsure of the set of moves available to Player 1, it is better for her to strategize in such a way so as to account for this potential jump in the winning set. In other words, if Player 0’s winning condition is at a level $n$ (say) of the hierarchy, she is better off strategising for level $n + 1$ given that she is unsure of Player 1’s moves and given that a set at level $n$ might undergo a jump to level $n + 1$.

Our example (1) is a linguistic example of what can happen if the complexity of one’s objective depends on the presence of unforeseen moves. Player 0, which we’ll take to be Quayle, has an alphabet $A$ (say) while Player 1 has an alphabet $B$ such that $A \subseteq B$. While Player 0 may or may not be aware of this fact, it seems that Quayle was in effect unaware of Bentsen’s surprise move. We also assume here that player 1 is an amalgam of several actual conversational participants as a simplification.

Let’s now look at the debate. The debate by the point of the exchange in (1) had touched on many other issues but repeatedly cycled back to what became the central question, summed up in
(1d). As we can glean from (1a), Quayle had tried to answer this question before by claiming that the question about his qualifications to be President was purely hypothetical; he was running for Vice-President, not President. However, this strategy did not achieve Quayle’s objective of reassuring doubters about his Presidential qualifications. So this time he tries a different strategy.

We can represent this fragment of the debate and its attendant strategic situation with an abstract way involving a set of states, which we’ll equate with discourse moves (or a sequence of discourse moves), linked by paths moving our agents from one state to the next. We can characterize the flow of the conversation then abstractly in terms of a game arena, which we represent as a graph \( (N_0, N_1, E) \), where the nodes \( N_0 \) and \( N_1 \) represent moves whose responses are controlled by player 0 and 1 respectively. \( N_0 \) nodes in the pictures below are depicted as circled nodes while those controlled by 1 are encased in rectangles. Let \( v_0 \) represent the prior and posterior debate moves which we will distribute in an abstract fashion to moderators and Bentsen. The details of this part of the debate don’t concern us here. Let \( v_1 \) represent the question asked of Quayle about his presidential qualifications. Quayle controls the response to this move and hence \( v_1 \) is circled. The debate has cycled now several times through to \( v_1 \), and \( v_2 \) being a previous response about the questions’ being hypothetical. Let \( v_3 \) symbolize the comparison with Kennedy, with his conclusion that he was every bit as qualified as the young Kennedy. The winning condition for this snapshot of the debate, however, is not just the move \( v_3 \) but a hypothetical response such as thank you. Senator from the moderators and an irrelevant comment from Bentsen, which would indicate that the answer to the question had been given, accepted, and that it was time to move on in the debate. This move is symbolized by \( v_4 \). And thus, the winning condition for Quayle was to first play \( v_3 \) followed by \( v_4 \), or \( v_2 \) followed by \( v_4 \).

The winning condition for Quayle was to first play \( v_3 \) followed by \( v_4 \), or \( v_2 \) followed by \( v_4 \).

Given \( v_1 \), Quayle clearly had a winning strategy for achieving \( \{ v_3, v_4 \} \) in the small arena on the top in Figure 2—just play \( v_3 \). It was also possible for him to play \( v_2 \), but his opponents did not let the conversation go to the desired state \( v_4 \) in the previous round of that question. So we could characterize his winning condition in the small arena as \( \Sigma_1 \) of reaching either \( \{ v_3, v_4 \} \) or \( \{ v_2, v_4 \} \). In fact, playing \( v_2 \) in the hope that the opponent might let him get to \( v_4 \) was the safer strategy in view of the expanded arena, and thus worth trying. While BM games are in fact deterministic, it is more reasonable to suppose that 0 was in a state of incomplete information about what 1 might do. We could represent such imperfect information about what move would be played by assigning to each arc a pair of probabilities representing the degree of certainty by 0 or 1 that the move would be played. As long as 0 assigned some non-0 probability to 1’s playing the sequence \( v_2v_4 \), it was worth trying. It turned out that playing \( v_3 \) was much riskier for Quayle than perhaps he imagined.

However, with the possibility of Bentsen’s making the move that he in fact did, the same winning condition in the larger arena would have to be characterized \( \Sigma_2 \) in the Borel hierarchy—to play \( v_3 \) but to guarantee that \( v_5 \) never got played by Bentsen. Given the graphs above of the moves played by Quayle and Bentsen, Quayle had no winning strategy for attaining his original winning condition. His best response would be to play \( v_2 \) again to \( v_1 \) if we assumed that there was at least a small probability that his interlocutors would play the move to \( v_4 \). But even then it would not guarantee the winning condition, as it didn’t before.
Our diagnosis as depicted in Figure 2 assumes that the moves available to Quayle were only $v_2$ or $v_3$ in response to $v_1$. There are, however, any number (in fact a countably infinite number) of responses he could have made. Had he been aware of the possibility of Bentsen’s response in $v_5$, he might have avoided the comparison entirely, or adumbrated the comparison with a concessive move underlined below in the following alternative to $v_3$:

$$(1d') \quad \text{Quayle: […]} \quad \text{"What kind of qualifications does Dan Quayle have to be president,"}(a) \quad \text{"What kind of qualifications do I have,"}(b) \quad \text{and \"What would I do in this kind of a situation?"}(c) \quad \text{And what would I do in this situation?} \quad (d) \quad […] \quad \text{I have far more experience than many others that sought the office of vice president of this country \((e)\). Although I would not presume to be the man or the towering political figure that John Kennedy turned out to be,(f) I have now as much experience in the Congress as Kennedy did when he sought the presidency.}(g) \quad \text{I will be prepared to deal with the people in the Bush administration}(h), \quad \text{if that unfortunate event would ever occur.} \quad (i)$$

If we take a look at $v_3$ from the perspective of discourse structure, we see a quite complex construction. We have labeled the elementary discourse units in $(1d')$ (a), (b), … (i). Quayle asks four questions in (a-d). (a) is the main or topic question while (b)-(d) form a complex constituent elaborating on (a). They sum up what he has been asked previously on this topic. He then gives a complex indirect answer involving several constituents (e)-(i). One way of indicating this is to make the Indirect Question Answer Pair relation of SDRT hold between (a) and a complex discourse unit consisting of the graph built from (e- i). But what is the point of this concessive move? It’s not part of the answer to the question in (a); it doesn’t say what qualifications Quayle has or how he can deal with certain situations that would show indirectly that he has the requisite qualifications. The concessive move is what (Asher et al., 2011) call a dangler; while it is not part of the answer to the question and so lies outside the question answerhood relation between (a) and the CDU, it is designed to play a particular discourse role. The discourse structure looks like this, where Con is short for the SDRT discourse relation Continuation, Cond for Conditional and IQAP for Indirect question answer pair. The dotted arrows represent membership relations of nodes in a CDU. This means, for instance, that IQAP($a, \pi_1$), where $e, g,$ and $\pi_2$ are constituents of $\pi_1$ (and hence nodes of the graph for $\pi_1$).

The point of the concessive move in (f) is to head off attacks that the opponents might make on the answer that Quayle presents in his turn, in particular on the comparison he makes between JFK and himself. In the SDRT annotated corpus ANNODIS (Afantenos et al., 2012a), danglers are quite frequent, and represent about 10% of the discourse moves. However, in monologue, their role is often unclear; they often are used to make commentary or give background material. This use of a dangler, however, is argumentative: it is used to head off an attack that would deviate the conversation from 0’s preferred continuation of $v_3, v_4$. It does so by denying the major premise behind $v_5$, which is in making the comparison Quayle was not only talking about qualifications but implicated at least that he was similar to JFK in other ways. This would have been effective. It would have anticipated Bentsen’s retort and rendered it much less effective, thus permitting a move from $v_3'$, our modification of $v_3$, with the concessive move to the desired sequence $v_1, v_3', v_4$.

So how would such a move change the expanded arena in Figure 2? We propose the fol-
How do we generalize our observations? We have drawn links from moves simply intuitively, but there are constraints we believe that strongly constrain what moves are possible after a given move. As an example, we propose the following:

**Proposition 2**

If a move $\alpha$ presupposes $\phi$ and a move $\beta$ is such that $\beta \models \neg \phi$, then there is no link between $\alpha$ and $\beta$. I.e. $\alpha$ cannot be a response to $\beta$.

This constraint follows in SDRT, if a constituent in $\alpha$ links with any right veridical relation to a constituent in $\alpha$ in (a relation is right and left veridical just in case $R(a, b) \rightarrow (\forall a \land \forall b)$, where $a, b$ range over propositions). More generally, having such a link between $\alpha$ and $\beta$ entails that $\alpha$ must be false if it attaches to $\beta$. As speakers do not say things that must be false in the context, there is no link possible between $\alpha$ and $\beta$. While might think that Correction could hold between $\beta$ and $\alpha$, Correction is right veridical and the correcting content cannot be presupposed but must be part of the preferred content of the correcting constituent.

Our generalization shows one way then of blocking potentially damaging moves. And it also accounts for why though Bensten could always have used $v_5$ after Quayle had played $v'_3$, it would have been ineffective, because it would presuppose something that was explicitly denied by the constituent to which it attaches. Bentsen’s response then as it stands would have been incoherent. A possible response would have been: you’re right. You are no Jack Kennedy, but that would not have attacked the position of $v_3$ and would simply have sounded petulant. In which case the path from $v_5$ to the desired state $v_4$ would have been possible. It would have better in this hypothetical situation for Bentsen to remain silent.

However, given that Quayle was unaware of Bentsen’s come-back move in (1e), what could have he done? That remains a mystery to us, and a topic for future work.

## 4 Conclusions and prospects

We have presented a novel framework for the analysis of conversation using BM games, presenting several technical results and then drawing consequences for them for linguistic analysis. We have but scratched the surface of a very rich framework for the analysis of conversation. In future work, we hope to expand on these ideas.

### References


