

# Computing the meaning of the assertive speech act by a software agent

Brian Nolan

Institute of Technology Blanchardstown, Dublin, Ireland

brian.nolan@itb.ie

Received: 2 March 2017 / Accepted: 30 April 2017 / Published: 19 June 2017

## *Abstract*

This paper examines the nature of the assertive speech act of Irish. We examine the syntactical constructional form of the assertive to identify its constructional signature. We consider the speech act as a construction whose meaning as an utterance depends on the framing situation and context, along with the common ground of the interlocutors. We identify how the assertive speech act is formalised to make it computer tractable for a software agent to compute its meaning, taking into account the contribution of situation, context and a dynamic common ground. Belief, desire and intention play a role in *what is meant* as against *what is said*. The nature of knowledge, and how it informs common ground, is explored along with the relationship between knowledge and language. Computing the meaning of a speech act in the situation requires us to consider the level of the interaction of all these dimensions. We argue that the contribution of lexicon and grammar, with the recognition of belief, desire and intentions in the situation type and associated illocutionary force, sociocultural conventions of the interlocutors along with their respective general and cultural knowledge, their common ground and other sources of contextual information are all important for representing meaning in communication. We show that the influence of the situation, context and common ground feeds into the utterance meaning derivation. The '*what is said*' is reflected in the event and its semantics, while the '*what is meant*' is derived at a higher level of abstraction within a situation.

**Keywords:** Assertive speech act, Irish, situation, knowledge, common ground, software agent

## **1. INTRODUCTION**

It is widely known and accepted that *what is said* is not always *what is meant*. The nature of the communication is important for the determination of an actual utterance, the actual speech act, by a hearer in a dialogue situation. That is, to assist in the unpacking of meaning, an understanding of the nature and structure of the utterance is needed. Additionally, so too is the

speaker's<sup>1</sup> intention and the hearer's recognition of it. What is interesting about this is that the fulfilment of a communicative intention resides in its recognition by the hearer. An utterance therefore has an expression encapsulating an event with a linguistic structure and the utterance type identifies a speech act with an illocutionary force, and these are both connected in a meaningful way. The meaning of a speech act involves its situational context, content, common ground and S's communicative intention.

In this research study, we provide a characterisation of the ASSERTIVE speech act of Irish and its function, along with the syntactic nature and structure of the linguistic constructions that carry this particular speech act. We examine the role of the situation of the utterance, context and common ground pertaining to the interlocutors of the speech act. We are guided by the quote from Stalnaker:

Let me begin with some truisms about assertions. First, assertions have content; an act of assertion is, among other things, the expression of a proposition—something that represents the world as being a certain way. Second, assertions are made in a context—a situation that includes a speaker with certain beliefs and intentions, and some people with their own beliefs and intentions to whom the assertion is addressed. Third, sometimes the content of the assertion is dependent on the context in which it is made, for example, on who is speaking or when the act of assertion takes place. Fourth, acts of assertion affect, and are intended to affect, the context, in particular the attitudes of the participants in the situation; how the assertion affects the context will depend on its content (Stalnaker 1978, 78–95).

The organisation of this paper is as follows. In section §2 next, we examine the nature and content of utterances and issues to do with the extent of the interlocutors' knowledge and the role of common ground in the situational environment in which dialogue typically unfolds. We then, in §3, explore issues relating to mediating knowledge and language within a conversational software agent (CSA). In §4 we discuss issues of knowledge representation and the role this plays within a CSA. Section §5 foreground the important of the situation and context of the speech and how information from these saturate underspecified important elements in the interpretation of the meaning of the speech act utterance. In §6, the syntactic expression of the assertive speech act construction of Irish is characterised and its constructional schema identified, while in §7, the expression and formalisation of the assertive speech act of Irish is motivated. We finish in §8 with a concluding discussion on the dynamics of the meaningful unpacking of the meaning of a speech act and how this depends on the situation in which the dialogue utterance occurs and the context of the situation.

## **2. THE NATURE AND CONTENT OF UTTERANCES**

### **2.1 THE EXTENT OF THE INTERLOCUTOR'S KNOWLEDGE**

Exchanging words in a conversational dialogue is essentially a form of social that typically

---

<sup>1</sup> We use S for speaker and H for hearer throughout the paper.

unfolds in the context of a clear, well-defined social environment and situation. In such situations and their associated contexts, we initially build common ground and determine its scope and parameters, and assess the extent of the interlocutor's knowledge to inform and progress the conversation towards common understanding. With people we know, we can rely on our shared knowledge and common ground to facilitate our communication. Communication is successful when H determines and unpacks S's intentions from the type of the utterance speech act delivered.

Determining the nature and content of utterances can be quite tricky but, as people, we tend to be good at this, given a reasonable common ground. Utterances can be ambiguous, or a person may speak figuratively and somewhat indirectly. The role of constructing, maintaining and leveraging a functioning common ground in support of successful communication can be difficult depending on the closeness (or not) of the background of the conversational interlocutors. When one of the interlocutors is a *conversational software agent* (CSA) then formalisation and specification as to what is considered in deriving utterance meaning, such that it can be computed in the software, is significant.

## 2.2 THE THEORY OF SPEECH ACTS AND LINGUISTIC COMMUNICATION

The theory of speech acts was derived to deal with natural language utterances that are not easily classified as being true or false, but rather, in the situation embracing their actual utterance, are actions in themselves. Speech act theory was extended to deal with all utterances based on the key insight that all utterances are actions of some sort (Austin 1975; Bach & Harnish 1979; Searle 1969). A speech act is usually identified with its associated illocution and this illocution is usually seen to have two parts: an illocutionary force and a proposition (Searle, 1969). The illocutionary force distinguishes, for example, an assertion from a declaration, or an order from a promise; the proposition of the illocution describes the state of the world that is, respectively, asserted, ordered or promised. The propositional part of an illocution specifies the state of the world that it is relates to. An assertive speech act asserts of that state that it holds currently (though the proposition could be temporal in nature).

A speech act is associated with at least three distinct actions:

- (1)
  - a) A locution: The physical utterance.
  - b) An illocution: The conveying of the speaker's intent to the hearer. That is, the pragmatic 'illocutionary force' of the utterance, thus its intended significance as a socially valid verbal action.
  - c) A number of perlocutions: Actions that occur as a result of the illocution, including its actual effect, such as persuading, convincing, scaring, enlightening, inspiring, or otherwise getting someone to do or realize something, whether intended or not (Austin 1975).

Within a speech act, an intention is intended to be recognised, and the fulfilment of that intention consists of its recognition by H. The sort of intention with this feature expresses a belief or desire. Then, the act of linguistic communication is successful if H identifies the belief, or desire that S expresses. That is, communication occurs in virtue of H recognising the intention of S.

Then, the linguistic communication is identified on the basis of what is said, together with mutual contextual beliefs in a co-constructed common ground. What is meant by an utterance is carried in part by what is said, the type of speech act uttered, the utterance context and the contribution of common ground. The hearer can proceed to the identification of the speaker's illocutionary act through determining the speech act via its constructional pattern – its constructional signature, and the belief or desire that the speaker is expressing as an intention. That act of communication is successfully achieved if the hearer identifies the belief or desire expressed, in the way that the speaker intends it to be identified. Therefore, to inform someone of something is not only to express a belief in it but also to express one's intention that the hearer believes it. Belief, desire and intention are interrelated in speech acts and communication. In a dialogue, of course, the role of S and H swap as conversational turn are taken.

### **3. MEDIATING KNOWLEDGE AND LANGUAGE IN A SOFTWARE AGENT**

Identifying the forms of expression of the ASSERTIVE speech act constructions of Irish, and formalising these speech acts, are challenges we address in this paper. We concentrate on characterising the syntactic expression of the assertive speech act based on its constructional signature and its formalisation within a situation such that its meaning as an utterance can be determined and computed. Additionally, formalising the semantics of communications has been an on-going challenge in computational linguistics and computer science (Traum 1999), as multiple views of what can be formalised are possible, including what constitutes an evolving dynamic common ground over a discourse.

Speech acts are classified into types and each type has a different function in communication: ASSERTIVES (Conveys information to H and is true or false), DIRECTIVES (Querying: Elicits information from H; Ordering: Demands action from H and causes H to behave in certain ways; Requesting: Elicits action from H or information from H), COMMISSIVES (Promising: Commits S to an action; Threatening: Commits S to an action that H does not want), DECLARATIVES (Causing events in themselves).

A model of conversational software agents in a computational framework was advanced in Nolan (2014a) (see Figure 1) and we refine this here with regard to the ASSERTIVE speech act (Stalnaker 1978). The model builds on the notion of a speech act and assumes a functional model of grammar, such as Role and Reference Grammar (RRG) (Nolan 2012, Van Valin 2005). Additionally, this computational framework for conversational software agents provides for the construction and maintenance of a common ground (Stalnaker 1998, 1999a, 1999b; Clark 1996; Clark & Carlson 1982) in a discourse workspace to underpin the conversational interaction, where the thinking on the nature of what constitutes a common ground is based on Kecskes and Zhang (2009).

Kecskes and Zhang (2009) propose an integrated concept of common ground, in which both a core common ground of assumed shared (cultural and ontological) knowledge, suitably represented, and an emergent common ground, showing emergence through use, converge to construct a rich background for communication. As such, common ground is a dynamic construct of shared knowledge that is mutually constructed by interlocutors (CG.S and CG.H) throughout the communicative process as a dynamic part of the CONTEXT. Here, speech act theory, implemented in software (with speech act constructions), forms the basis for successful communications, based on the idea that with language you not only make statements, but also perform actions.

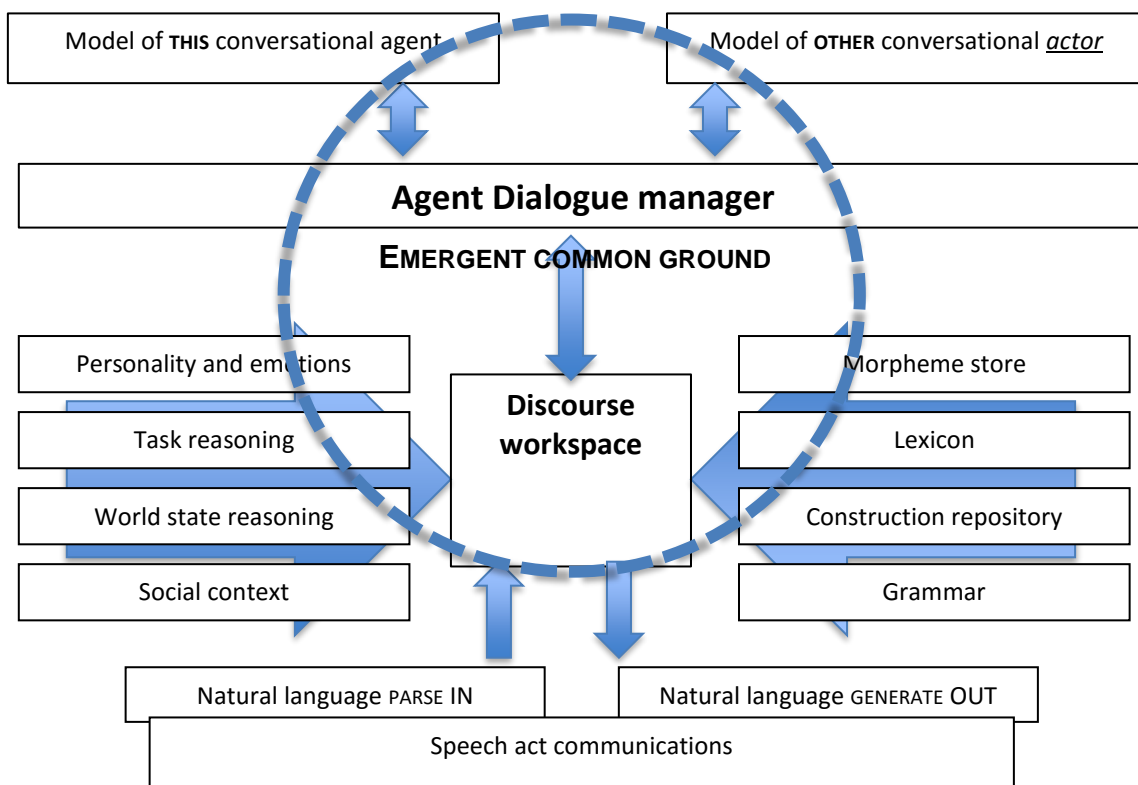


FIGURE 1: FRAMEWORK FOR A LANGUAGE UNDERSTANDING CONVERSATIONAL SOFTWARE AGENT SYSTEM WITH A DYNAMIC COMMON GROUND

As a part of the formalisation of the speech act of Irish, we will present common ground, for both S and H, as specialised knowledge representations pertinent to the communication process and the construction of a dynamic common ground. Contributing to knowledge management in a conversational software agent system, it is necessary to represent several important aspects (2) pertinent to the characterisation of the speech act appropriately (Nolan 2014). For the ASSERTIVE speech act, points (2a–e) are of concern here.

- (2) Important aspects of a conversational agent-based system
  - a. The set of *beliefs* that the agent has at any given time;
  - b. The *goals* that agent will try to achieve;
  - c. The *actions* that agent performs and

- d. The knowledge of the *effects* of these actions;
- e. The *environmental information / knowledge* the agent has (which may be incomplete or incorrect);
- f. The *ongoing discourse interaction* that agent has with other (human) agents and their environment over time;
- g. Human *language understanding* and *conversation tracking* over a discourse.

In order to define the cognitive states for an agent and use them to describe the various key dimensions and factors, PRECONDITIONS, POST-CONDITIONS, we need to employ several predicates that have a reserved meaning (3).

- (3) Cognitive states for an agent (Nolan 2014).
  - a. **BELIEVE'** (Agent, P), has the meaning that the agent believes that P is true for the agent, where P is an expression in a human natural language.
  - b. **KNOW'** (Agent, P) expresses a state of knowledge of the agent with respect to P.
  - c. **WANT'** (Agent, P) means that agent desires the event or state coded by P to occur.
  - d. **INTEND'** (Agent, P) means that the agent intends to do P.

To support this agent, and motivate the interface between knowledge and language mediated by the speech act through the dynamic common ground of the interlocutors (human and software agent), the representation of knowledge is an important dimension of the model. We need this, for example, when considering what is encoded as salient within a dynamic common ground, or what is a shared social and cultural knowledge.

#### **4. KNOWLEDGE REPRESENTATION AND CONVERSATIONAL AGENTS**

Knowledge representation is typically represented within an ontology which functions as a representation of some part of the world. Being computationally tractable, ontologies are amenable to formal methods in the algorithms for processing ontologies and the various linguistic constructions in a discourse.

Knowledge representation is important for a software agent to enable its functioning and to mediate the interface between knowledge and language. A conversational software agent, as envisioned here represents its knowledge across an internal state model, an external interaction model plus a model of language. The internal model of the agent is concerned with the internal state of the agent, based upon the intersection at any given time of the agent's internal beliefs, desires, and intentions. The external model of the agent is composed of an interaction model with its world (human and 'other' agent). The intersection of the agent's internal beliefs, desires, and intentions are key to determining the meaning of the speech act utterance, in this instance, the assertive.

Knowledge representation is used to encode knowledge in an agent's knowledge base in a machine-tractable form, such that it can be used by the conversational agent software system to

perform efficiently, optimally and effectively in working with knowledge in its interface with language. A knowledge base is a core part of any conversational agent software system to map objects and relationships of the real world to computational objects and relationships, such that these are available to the software agent as part of its management of its own and its users' common ground (CG). What an agent knows, or believes they know, desire and want, and therefore intend to do informs the utterance speech act. At the interface between knowledge and language we touch upon elements of deontic and epistemic modality<sup>2</sup>, along with evidentiality as they support the illocutionary force of the speech act.

Ontological knowledge attempts to capture our understanding of a given information domain and the entities in that domain (Periñán-Pascual & Arcas Túnez 2007, 2010) and in many instances this is modelled computationally (Periñán-Pascual and Mairal Usón 2009; Ruiz de Mendoza, & Mairal Uson 2011). In the world of conversational agent software systems, the domain-specific knowledge is captured and typically, there would be multiple knowledge domains. This knowledge is utilised in the formation and maintenance of the common ground of the speakers (CG.S) and the common ground of the hearer (CG.H).

The types of knowledge characterised and which is found in common ground relates to declarative, procedural, heuristic, meta and structural knowledge. Declarative knowledge regarding concepts, facts and entities. This type of knowledge describes what is known and includes simple statements that are asserted to be either true or false. This also includes a matrix of attributes and their values so that an entity or concept may be fully described. Procedural knowledge is to do with processes, rules strategies agendas and procedures. This type of knowledge describes how something operates or how a problem is solved, and provides directions on how to do something. Heuristic knowledge describes our experiential knowledge that guides the reasoning process. It is empirical and represents the knowledge compiled through the experience of solving past problems. Meta-knowledge is high-level knowledge about the other types of knowledge and how to use them, and describes knowledge about knowledge. We use this type of knowledge to guide our selection of other types of knowledge for solving a particular issue. This type of knowledge is used to enhance the efficiency of our reasoning by directing the reasoning processes into the most promising area. Structural knowledge is to do with our sets of rules, concept relationships and concept to entities relationships. It describes actual knowledge structures within our overall mental models. Our mental model of concepts, sub-concepts, and entities with all their attributes, values, and relationships is typical of this type of knowledge. The function of any knowledge representation in an ontology is to capture essential features of a class of things in a domain area and make that information available as required to describe some particular thing.

The strategies for successful knowledge representation include use of logical schemes of predicate or propositional calculus; networked schemes of conceptual graphs or semantics nets;

---

<sup>2</sup> Modality in Irish has been characterised in Nolan (2008).

procedural schemes, for example, IF (CONDITION) THEN (DO\_ACTION) RULES; structured schemes consisting of scripts and frames. Logical schemes represent knowledge symbolically, while inference rules are based on clearly defined syntax and semantics. In procedural schemes, knowledge is represented as a set of instructions for problem-solving that allows us to modify a knowledge base easily and to separate a knowledge base from an inference mechanism. Networked schemes use a graph to represent knowledge where the various graph nodes display concepts in a domain while the edges define relationships between the entities, their attributes and the values of the attributes. Structured schemes extend networked representations by displaying each node in a graph as a complex data structure.

## 5. THE SITUATION AND CONTEXT OF THE SPEECH ACT

In this research study, we posit that a speech act meaning must be interpreted in the local context of a given situation. A situation is considered to be a structured entity with certain attributes that serves as a unifying device to link semantics to events through to syntax, and onwards to utterance meaning. The idea of a situation as important for utterance meaning has a strong respectable history in the philosophy of language and can be found in, for example, Austin (1975) with regard to speech acts, Barwise (1981, 1988) and Barwise and Perry (1983) within situation theory, and Sag, Wasow and Bender (2003) for HPSG. In Nolan (2017), we argued for a certain structure of a situation (4) with specific components. In this account relating to the ASSERTIVE speech act we suggest that this now needs to be expanded in key areas (5) to include the constructional signature, illocutionary force, initial context at the time of the speech act utterance and containing the initial common ground of the speaker S and hearer H along with the preconditions that exist, the speech act proposition, the belief, desire and intention (BDI) cognitive states of the speaker, and the post-context '*as it is*' after the utterance of the speech act. The events and arguments of the situation remain represented, of course, as befits the speech act.

### (4) Constructional schema<sup>3</sup> of a situation

<b>Situation</b>	s
<b>Event(s)</b>	< v <sub>1</sub> (... v <sub>n</sub> ) ... >
<b>Arguments</b>	< ARG <sub>1</sub> , (ARG <sub>2</sub> , ..., ARG <sub>n</sub> ) ... >
<b>Semantics</b>	Nexus-juncture relations
<b>Location.time</b>	(time)
<b>Location.space</b>	(place – may be unspecified)

### (5) Constructional schema to support speech act meaning resolution

SITUATION
-----------

<sup>3</sup> The linking of constructions, considered as grammatical objects, into functional models of grammar is discussed in detail in Nolan and Diedrichsen (2013).



	Loc.time Loc.space
SIGNATURE	Utterance syntactic pattern
ILLOCFORCE	IL
INITIAL CONTEXT	(CommonGround) InitialCG.S InitialCG.H Precondition(s)
PROPOSITION	Prop
BELIEF	B
DESIRE	D
INTENTION	I
POST CONTEXT	Postconditions PostCG.S PostCG.H

The illocutionary force is a fundamental primitive. The illocutionary points are *assertive*, *directive*, *commissive*, *declarative* and *expressive*. The illocutionary point of the type of illocutionary act is achieved if the act is successful. The illocutionary force will have a (scalar) degree of strength associated with it. The achievement mode suggests the sets of preconditions under which the illocutionary point has to be achieved in the performance of the speech act, including the appropriate level of authority of the speaker. The situational preconditions constrain what can be in the proposition for a specific illocutionary force. This depends directly on the situation and context framing the utterance. As well, certain preconditions hold for the successful performance of an illocutionary act. We can view these preconditions as ranging over the cognitive state of the agent. The conditions relate to the cognitive state of the agent with respect to Belief, Desire and Intention. These conditions may additionally have a degree of strength.

## 6. THE ASSERTIVE SPEECH ACT OF IRISH

In this section, we examine the assertive speech act found in Irish. We explore the expression of the speech act and its intended meaning, over and above what is simply said. We appeal to belief, desire and intention as component parts of the speech act. In the determination of uttered meaning, we additionally appeal to a logical form based on the logical structures of RRG, along with a predicate calculus type notation to encode belief, desire, intention and obligation. This gives the formalisation of the situation, context, common ground, and the speech act, a logical form amenable to treatment in software.

The set of those speech acts that express the speaker's belief, with their desire and intention that the hearer forms (or continues to hold) a similar belief are, as a grouping, called Constatives. Included within the set of constatives is the ASSERTIVE speech act that we discuss here for Irish. Assertives commit *S* to a proposition being true such that, in uttering the assertive, *S* asserts that proposition if *S* expresses a) the belief that the proposition holds, and b) the intention that *H* believe that proposition. An assertive is satisfied simply if its proposition is *true* at the moment the utterance is made. Therefore, the assertion *Tá an doras dúnta* 'The door is closed' is satisfied in this context of the utterance where it is true that the door is, in fact, closed. Broadly, this can occur in two forms in Irish, given in (6) and (7). The first form (6) used a syntactic construction with an auxiliary form to state a fact within the context of some situation. The second form (7) uses a lexical verb and has an actor and undergoer.

## (6) Assertive – utterance form 1

- a. *Tá an doras dúnta*  
 AUX.PRS DET door:N closed:VA  
 The door is closed.  
 [**be'** [door, **closed'**]]
- b. Constructional signature: [AUX.TNS NP VA]

## (7) Assertive– utterance form 2

- a. *Dhún Lorcan an doras*  
 Close:V.PST Lorcan DET door:N  
 Lorcan closed the door.  
 [**do'** (Lorcan) **close'**(Lorcan, door)  $\wedge$  **be'** [door, **closed'**]]
- b. Constructional signature: [V.TNS NP NP]

Assertives include affirmations, allegations, statements, claims, tellings, and so on, and examples typically include utterances formed with the following (and related) verbs (8–15): *dearbhaigh* 'affirm', *maigh* 'allege, assert, claim', *fógair* 'declare', *séan* 'deny', *léirigh* 'indicate', *caomhnaigh* 'maintain', *abair* 'say', *áitigh* 'submit'. Of course, this list is not exhaustive, merely indicative.

(8) *Dearbhaigh* 'affirm'

- Dhearbhaigh sí go raibh sí ag tacú*  
 Affirm:V.PST 3SG.F to:PREP be:AUX.PST 3SG.F at:PREP supporting:VN  
*leis an mbille*  
 with:PREP DET bill:N  
 She affirmed she was supporting the bill/

- (9) *Maígh* ‘allege, assert, claim’  
*Maítear gur cheil siad eolas*  
 Allege:V.PST+3PL that:PREP lost:V.PST 3PL information:N  
 They are alleged to have withheld information.
- (10) *Fógair* ‘declare’  
*D’fhógair siad go síneoidís an comhaontú*  
 PRT+declare:V.PST 3PL.NOM to:PREP sign:V.FUT+3PL DET agreement  
 They declared that they will sign the agreement.
- (11) *Séan* ‘deny’  
*Shéan sí arís agus arís eile gur mharaigh sí iad*  
 Deny:V.PST 3SG.F again CONJ again other that kill:V.PST 3SG.F 3PL.ACC  
 She repeatedly denied killing them.
- (12) *Léirigh* ‘indicate’  
*Léirigh an tástáil go raibh feoil chapaill ann*  
 Indicate:V.PST DET test:N to:PREP AUX.PST meat:N horse:N there:DEIC  
 Lit: The test indicated that horsemeat was there.  
 The test indicated the presence of horsemeat.
- (13) *Caomhnaigh* ‘maintain’  
*Chaomhnaíomar ár sean-nósanna*  
 Maintain:V.PST+1PL our:ADJ.POSS old:ADJ+customs:N  
 We maintained our traditional customs.
- (14) *Abair* ‘say’  
*Dúirt sí go raibh sé an-deacair*  
 Say:V.PST 3SG.F to:PREP AUX.PST 3SG.M very:INTENSIFIER+difficult:ADJ  
 She said that it was very difficult.
- (15) *Áitigh* ‘submit’  
*D’áitigh a dhlíodóir gur iomrall aithne a bhí ann*  
 Submit:V.PST 3SG.M.POSS.ADJ solicitor that:PREP  
 mistake identify REL AUX:PST there:DEIC  
 His solicitor submitted that it was a case of mistaken identity.

We next discuss the formalisation of these assertive speech acts of Irish.

## 7. FORMALISATION OF THE ASSERTIVE SPEECH ACT

In arriving at an understanding of the assertive utterance meaning, we will appeal to the idea of a context of some situation, specific to S and H, at the moment of utterance. We will also appeal to the idea that S is motivated by a set of beliefs, desires and intentions and that this influences his discourse behaviour towards H. S will additionally make an assessment of the extent of the shared common ground with H and accordingly, through the discourse, construct the common ground and maintain it appropriately. Both S and H each have a common ground (which we label as CG.S and CH.H respectively) and we assume that some but not all of this overlaps with common knowledge of various kinds.

A formalisation of the assertive speech act for form 1 (6) is given in (16) and the corresponding formalisation for (7) is given in (17). In this formalisation we define the speech act construction and identify the Sit(uation), Cont(ext), CG.S (CommonGround.S), CG.H (CommonGround.H), Precon(ditions), Prop(osition), B(elief), D(esire), I(ntention) states, and Postcon(ditions) resulting from the utterance of the assertive speech act. We can assume that the illocutionary force of a message transmitted is the one that is obvious from its syntactic form of the utterance construction. We call this syntactic form the utterance its CONSTRUCTIONAL SIGNATURE. This syntactic pattern, the speech act signature, assists the software agent in determining which speech act is active and, correspondingly, assists in determining the illocutionary force of the utterance. In (16), we identify the situation with a label S and the context as C, while common ground for the S and H is denoted as CG.S and CG.H respectively. The relevant contents of common ground for S and H are explicitly identified. While the CG.H does not indicate content at this point, for CG.S we show this as containing two logical structures (LS): 1) [**exist'** (door)] and 2) [**be'** [door, **open'**]]. These act as the precondition for S in making the assertive utterance. We indicate in (17) a similar formalisation for assertive form 2 showing the actor and undergoer within the various logical structures and in the B, D, and I states.

Correspondingly, the B, D and I for S is shown. For B, we use a predicate **BEL'** (LS), for D, we use a predicate **WANT'** (LS) and for I, we use a predicate **INTEND'** (LS). Reading these, S BELIEVES the door is closed. S desires (= **WANTS'**) that H BELIEVE the door is closed. S therefore intends that H BELIEVE the door is closed as a consequence of the assertive speech act. The resulting postcondition is that H BELIEVES the door is closed. The proposition of the assertive is that the door is closed.

The conditions of satisfaction of different speech acts in the same class are identical. Their differences reside in the resolution of a number of pragmatic factors, e.g. the compatibility of the common ground of the agents involved and various matters of cultural convention.

(16) Assertive - Formalisation of utterance form 1

SIT	S
LOC.TIME	time
LOC.SPACE	location

SIGNATURE	AUX.TNS NP VA
IllocForce	ASSERTIVE
INITIAL CONTEXT	C(ONTEXT) 1. Ontology: DOOR IS_A thing 2. Ontology CLOSE IS_A event process
InitialCG.S	CG.S 1. [ <b>exist'</b> (door)] $\wedge$ 2. [ <b>be'</b> [door, <b>open'</b> ]
InitialCG.H	CG.H 1. <u>    </u>
Precon	1. [ <b>exist'</b> (door)] $\wedge$ 2. [ <b>be'</b> [door, <b>open'</b> ]
Prop	[ <b>be'</b> [door, <b>closed'</b> ]
B	BEL'(S, [ <b>be'</b> [door, <b>closed'</b> ])
D	WANT'(S, BEL'(H, [ <b>be'</b> [door, <b>closed'</b> ]))
I	INTEND'(S, BEL'(H, [ <b>be'</b> [door, <b>closed'</b> ]))
POST CONTEXT	BEL'(H, [ <b>be'</b> [door, <b>closed'</b> ])
Postcon	BEL'(H, [ <b>be'</b> [door, <b>closed'</b> ])
PostCG.S	CG.S 1. [ <b>exist'</b> (door)] $\wedge$ 2. [ <b>be'</b> [door, <b>closed'</b> ]
PostCG.H	CG.H 1. [ <b>exist'</b> (door)] $\wedge$ 2. [ <b>be'</b> [door, <b>closed'</b> ]

(17) Assertive - Formalisation of utterance form 2

SIT	<i>this</i> .SIT
LOC.TIME	time
LOC.SPACE	location
SIGNATURE	V.TNS NP NP
ILLOCF	ASSERTIVE
INITIAL CONTEXT	C 1. Ontology: DOOR IS_A thing: 2. Ontology: LORCAN IS_A person 3. Ontology CLOSE IS_A event process
InitialCG.S	CG.S 1. [ <b>exist'</b> (door)] $\wedge$ 2. [ <b>be'</b> [door, <b>open'</b> ]
InitialCG.H	CG.H 1. <u>    </u>
PRECON	1. [ <b>exist'</b> (door)] $\wedge$ 2. [ <b>be'</b> [door, <b>open'</b> ]

PROP	$[\mathbf{do}'(\text{Lorcan}) \mathbf{close}'(\text{Lorcan}, \text{door}) \wedge \mathbf{be}'[\text{door}, \mathbf{closed}']]$
B	$\text{BEL}'(\text{S}, [\mathbf{do}'(\text{Lorcan}) \mathbf{close}'(\text{Lorcan}, \text{door}) \wedge \mathbf{be}'[\text{door}, \mathbf{closed}']])$
D	$\text{WANT}'(\text{S}, [\mathbf{do}'(\text{Lorcan}) \mathbf{close}'(\text{Lorcan}, \text{door}) \wedge \mathbf{be}'[\text{door}, \mathbf{closed}']])$
I	$\text{INTEND}'(\text{S}, \text{BEL}'(\text{H}, [\mathbf{do}'(\text{Lorcan}) \mathbf{close}'(\text{Lorcan}, \text{door}) \wedge \mathbf{be}'[\text{door}, \mathbf{closed}']])$
POST CONTEXT	$\text{BEL}'(\text{H}, [\mathbf{do}'(\text{Lorcan}) \mathbf{close}'(\text{Lorcan}, \text{door}) \wedge \mathbf{be}'[\text{door}, \mathbf{closed}']])$
POSTCON	$\text{BEL}'(\text{H}, [\mathbf{do}'(\text{Lorcan}) \mathbf{close}'(\text{Lorcan}, \text{door}) \wedge \mathbf{be}'[\text{door}, \mathbf{closed}']])$
POSTCG.S	CG.S 1. $[\mathbf{exist}'(\text{door})] \wedge$ 2. $[\mathbf{be}'[\text{door}, \mathbf{closed}']]$
POSTCG.H	CG.H 1. $[\mathbf{exist}'(\text{door})] \wedge$ 2. $[\mathbf{be}'[\text{door}, \mathbf{closed}']]$

The meaning of a speech act utterance is the content of a message that is intended by the speaker and recovered by the addressee, under normal conditions where rules of rational principles of cooperative language, as used in the Gricean (Grice 1957, 1969, 1986) sense, apply in discourse. The work of Grice in pragmatics and speech acts is useful in that it enables us to understand how *speaker meaning*, what someone uses an utterance to mean (*what is meant*) arises from *sentence meaning*, the syntactic constructional form and meaning of an utterance (*what is said*). Grice essentially proposed that a speaker's meaning results from the assumption that the participants in a conversation are cooperating in an attempt to reach mutual goals and understanding in dialogue. Grice called this the Cooperative Principle and it has four maxims that cooperative conversationalists need to respect:

(18) Gricean Cooperative Principle

- 1) The maxim of quality      Speakers' contributions should be true.
- 2) The maxim of quantity      Speakers' contributions should be only as informative as the situation require and speakers should refrain saying either too little or too much.
- 3) The maxim of relevance      Contributions should relate to the purpose of the exchange.
- 4) The maxim of manner      Contributions should avoid obscurity and ambiguity and be clear, orderly and succinct.

We assume that the Cooperative Principle and its associated maxims apply in the agent framework. The speech act formalisation concerns the objective conditions of satisfaction for the speech act and its utterance meaning. Assertives, being claims of fact, are true or false. Computing the meaning of speech acts broadly corresponds to the conditions under which we would affirm that the given speech act had been satisfied. In this regard, intentions are a matter of what an agent really wants to achieve and reflect the agent's preferences, based on its beliefs and desires.

The development of a formal model of how the discourse meaning of the assertive speech act is composed from linguistic and non-linguistic components requires a formalisation of the speech act in its situation of occurrence and context, common ground, the belief, desire and intention of S (and H) and their respective common grounds along with several other important factors as discussed above. Utterance meaning is therefore highly context sensitive and is computed following a summation of information that is arrived at through different routes. We have outlined what these might be in our speech act formalisation.

In a discourse situation, utterance meaning, as understood by the conversational interlocutors, must be sensitive to information from many different sources (Figure 2) and the dimensions of the situation: it is determined partially from the syntactic structure of the expression used with the uttered sentence, but also from the situation and its actual environment, gestures, shared assumptions, cultural knowledge, shared general knowledge, and local context-specific knowledge.

We propose a partial sketch of how the various dimensions needed to derive utterance meaning link together in (19), based on our formalization of the assertive speech act in (17). In *this* situation, we have an utterance  $UTT_1$  containing an expression with a constructional signature of  $[V_{.TNS} NP NP]$ , signalling an illocutionary force of assertive. We represent this utterance as  $UTT_1: [\mathbf{do}' (S, \mathbf{say}' (S, EXPRESSION_1)) \& \mathbf{CAUSE} (\mathbf{hear}' (H, SA))]$  to indicate that the expression is the carrier of the *what is said* and which feeds into the speech utterance in the *what is meant* meaning derivation. We identify the interlocutors as S and H. We code an initial context of the situation showing a basic ontology. As part of the context, we show the initial common ground of S and common ground for H. We represent the utterance  $UTT_1$  as a logical structure in the style of RRG. At the event level, a simple<sup>4</sup> verbal predication is found in a sentence with a single clause containing a single verb and its arguments that denote a single event and the participants of that event (19). The clause will have a single core and a single nucleus and unfold within a particular time envelope. We schematically identify the semantics as a logical form where the influence of the situation, context and common ground feeds into the utterance meaning derivation. The '*what is said*' is reflected in the event and its semantics, while the '*what is meant*' is derived at a higher level of abstraction.

---

<sup>4</sup> Complex predications and complex events within a situation are reported on in Nolan (2017).

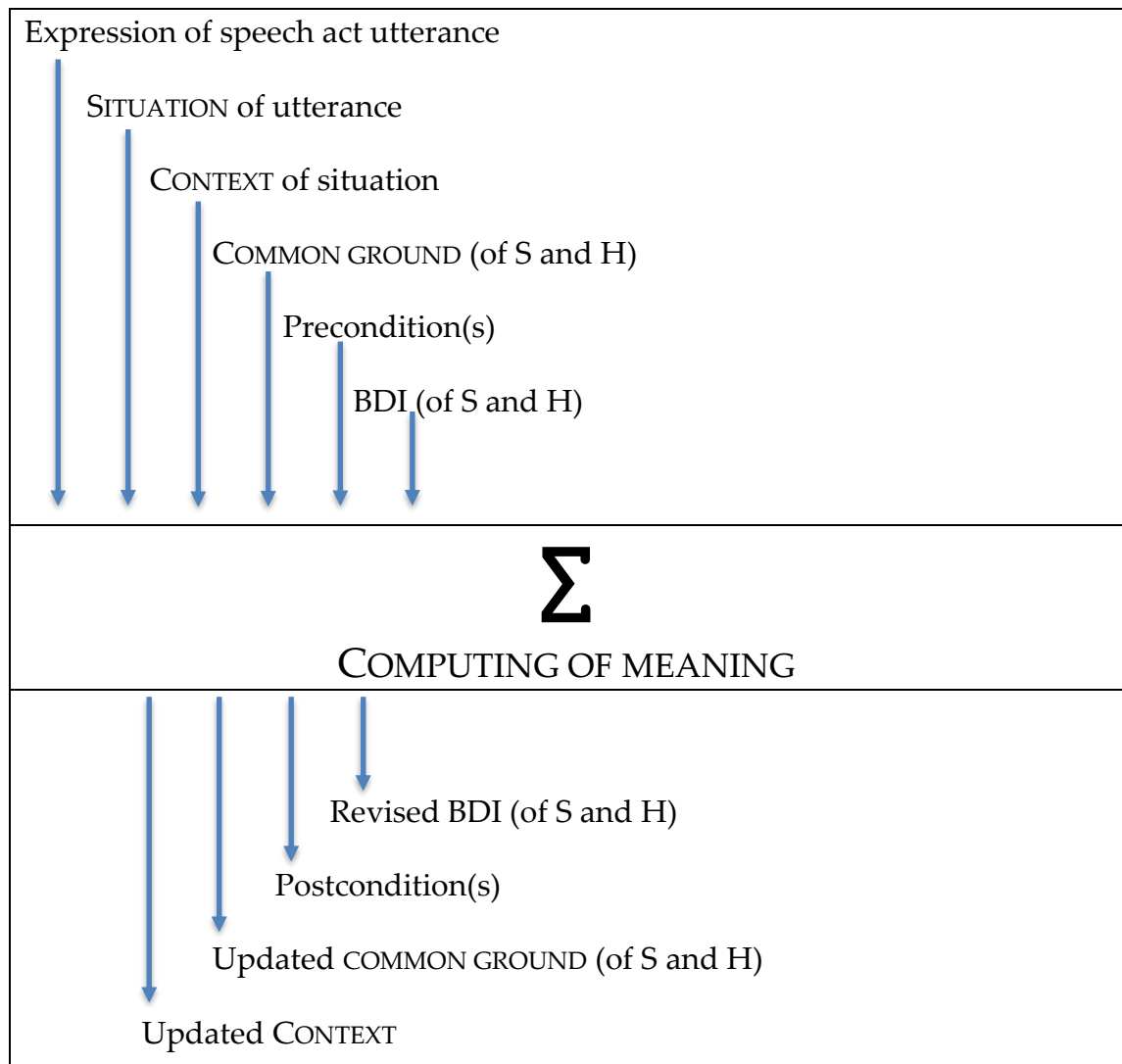


FIGURE 2. COMPUTING OF ASSERTION MEANING FROM MULTIPLE INFORMATION SOURCES

(19) Linking from speech act to meaning in the situation

<b>Situation</b>	<i>this.SIT<sub>a</sub></i>
<b>SIGNATURE</b>	<i>V<sub>.TNS</sub> NP NP</i>
<b>ILLOCF</b>	ASSERTIVE
<b>INITIAL Context</b>	C 1. Ontology: DOOR IS_A thing: < ARG <sub>1</sub> > 2. Ontology: LORCAN IS_A person: < ARG <sub>2</sub> > 3. Ontology CLOSE IS_A event process: <v <sub>1</sub> >
<b>Common ground</b>	CG.S 1. [ <b>exist'</b> (door)] ∧ 2. [ <b>be'</b> [door, <b>open'</b> ]] CG.H 1. ___
<b>Speaker</b>	S



<b>Hearer</b>	H
<b>ILLOCFORCE</b>	ASSERTIVE
<b>Speech act</b>	UTT <sub>1</sub> : [ <b>do'</b> (S, <b>say'</b> (S, EXPRESSION <sub>1</sub> )) & CAUSE ( <b>hear'</b> (H, SA))]
<b>Event(s)</b>	EXPRESSION <sub>1</sub> : [ <b>do'</b> (ARG <sub>1</sub> ) <b>close'</b> (ARG <sub>1</sub> , ARG <sub>2</sub> ) $\wedge$ <b>be'</b> [ARG <sub>2</sub> , <b>pred'</b> ]]  <v <sub>1</sub> >: <i>dún</i> 'close': [ <b>do'</b> (X <sub>1</sub> ) <b>close'</b> (X <sub>1</sub> , Y <sub>2</sub> ) $\wedge$ <b>be'</b> [Y <sub>2</sub> , <b>closed'</b> ]]
<b>Arguments</b>	< ARG <sub>1</sub> , ARG <sub>2</sub> >
<b>Semantics</b>	< <i>this</i> .SIT <sub>a</sub> < CG.S < CG.H <[ <b>do'</b> (S, <b>say'</b> (S, UTT <sub>1</sub> )) & CAUSE ( <b>hear'</b> (H, SA))] >>> Nuclear juncture: Single nucleus, with all ARGs within the single NUC
<b>Location.time</b>	time
<b>Location.space</b>	location

The contribution of the lexicon and the language grammar, along with the recognition of belief, desire and intentions in the type of situation and the associated illocutionary force, cultural conventions, general, specialist and cultural knowledge, common ground and other sources of information are all important in communication and for representing meaning in communication.

Computing the meaning of a speech act in the situation requires us to consider the level of the interaction of all these dimensions. In the semantics of linguistic interaction, compositionality is a property of structures that combine information conveyed through different linguistic as well as non-linguistic means of communication. The meaning of the sentence is the meaning of its utterance in its context. Computing meaning from a speech act is a dynamic process co-constructed in discourse and arises from the agent's intention to express and negotiate views and attitudes.

## 8. CONCLUDING DISCUSSION

In this paper, we have characterised the assertive speech act of Irish. We argued that, in order to compute the utterance meaning, a consideration of the situation of the assertion, its context and common ground is necessary. While this occurs dynamically and naturally between two human interlocutors in a dialogue, but when one of the interlocutors is actually a conversational agent then the factors whereby the computation is achieved needs to be spelt out formally. The immediate requirement is to actually specify the formal information needs that feed into the information flows of the meaning summation of the utterance speech act within the software. We have proposed a model of a conversational agent framework and, in this paper, treated the ASSERTIVE speech act of Irish.

We found that the meaningful unpacking of the meaning of a speech act, the '*what is meant*', depends on the situation in which the dialogue utterance occurs and the context of the situation.

This is the situation of the discourse speech act. The context and the situational frame contribute to the meaning over and above the *'what is said'*.

For an assertive speech act utterance that declares some fact that can resolve to some truth condition, this situational context informs common ground and interpretation of the speech act. This may include, for example, the contextual assignment of values to any indexical elements and variables in the logical structure of the utterance. The meaningful unpacking of the meaning of a speech act interaction involves consideration of S's intentions, plus their beliefs and desires, and the requirements posed by the common ground. The beliefs and desires motivate the sets of intentions of S.

## REFERENCES

Austin, John L. 1975 [1962]. *How To Do Things With Words*. (2nd edition) ed. by J.O. Urmson and Marina Sbisa. Oxford: Oxford University Press.

Bach, Kent and Robert M. Harnish. 1979. *Linguistic Communication and Speech Acts*. Cambridge MA: MIT Press. Barwise, Jon. 1981. Scenes and Other Situations. *The Journal of Philosophy*, 78: 369–97.

Barwise, Jon. 1988, *The Situation in Logic*. Stanford: CSLI.

Barwise, Jon and John Perry. 1983. *Situations and Attitudes*. Cambridge MA: MIT Press.

Clark, Herbert. 1996. *Using Language*. Cambridge MA: Cambridge University Press. <https://doi.org/10.1017/CBO9780511620539>

Clark, Herbert H. and Thomas B. Carlson. 1982. Hearers and speech acts. *Language* 58: 332–73. <https://doi.org/10.1353/lan.1982.0042>

Grice, H. Paul. 1957. Meaning. *Philosophical Review* 66: 377–388. Reprinted in Rosenberg and Travis (eds.) 1971: 436–44, and Steinberg and Jakobovits (eds.) 1971: 53–59. Reprinted in Grice 1986.

Grice, H. Paul. 1969. Utterer's meaning and intentions. *Philosophical Review* 78: 147–77. Reprinted in Grice, H. Paul. 1975. Logic and conversation. *Syntax and Semantics 3: Speech Acts*, ed. by Peter Cole and Jerry L. Morgan, 41–58. New York: Academic Press. Reprinted in Grice 1986.

Grice, H. Paul. 1986. *Studies in the Way of Words*. Cambridge MA: Harvard University Press.

Kecskes, Istvan and Fenghui Zhang. 2009. Activating, seeking, and creating common ground: A socio-cognitive approach. *Pragmatics & Cognition* 17:2 (2009), 331–355. Doi 10.1075 / p&c.17.2.06kec issn 0929–0907 / e-issn 1569–9943. Amsterdam: John Benjamins Publishing Company.

Nolan Brian. 2008. Modality in RRG: Towards a characterisation using Irish data. In Van Valin, Robert. (ed.). *Investigations of the Syntax-Semantics-Pragmatics Interface*. Studies in Language Companion Series 105. Amsterdam: John Benjamins Publishing Company. 147–159.

Nolan, Brian. 2012. *The syntax of Irish: A functional account*. Sheffield: Equinox.

Nolan, Brian. 2013. Constructions as grammatical objects: A case study of the prepositional ditransitive construction in Modern Irish. In Nolan, Brian, and Elke Diedrichsen. 2013. *Linking Constructions into functional linguistics*. [Studies in Language Companion Series 145]. Amsterdam: John Benjamins Publishing Company. <https://doi.org/10.1075/slcs.145.06nol>

Nolan, Brian, and Elke Diedrichsen. 2013. *Linking Constructions into functional linguistics*. [Studies in Language Companion Series 145]. Amsterdam: John Benjamins Publishing Company. <https://doi.org/10.1075/slcs.145>

Nolan, Brian. 2014. Extending a lexicalist functional grammar through speech acts, constructions and conversational software agents. In Nolan, Brian and Carlos Periñán. 2014. *Language processing and grammars: The role of functionally oriented computational models*. [Studies in Language Companion Series 150]. Amsterdam: John Benjamins. 143–164.

Nolan, Brian. 2017. The syntactic realisation of complex events and complex predicates in situations of Irish. In Nolan, Brian and Elke Diedrichsen. 2017) *Argument realisation in complex predicates and complex events*. [STUDIES IN LANGUAGE COMPANION SERIES 180]. Amsterdam and New York: John Benjamins Publishing Company. 13–41. <https://doi.org/10.1075/slcs.180.01nol>

Periñán-Pascual, Carlos and Francisco Arcas Túnez. 2007. Cognitive modules of an NLP knowledge base for language understanding. *Procesamiento del Lenguaje Natural* 39, 197–204.

Periñán-Pascual, Carlos and Francisco Arcas Túnez. 2010. The architecture of FunGramKB. *Proceedings of the Seventh International Conference on Language Resources and Evaluation*, European Language Resources Association (ELRA), 2667–2674.

Periñán-Pascual, Carlos and Ricardo Mairal Usón. 2009. Bringing Role and Reference Grammar to natural language understanding. *Procesamiento del Lenguaje Natural* 43, 265–273.

Ruiz de Mendoza, Francisco and Ricardo Mairal Uson. 2011. Levels of description and constraining factors in meaning construction: an introduction to the Lexical Constructional Model. In *Folia Linguistica* 42: 355-400.

SAG, Ivan A., Thomas Wasow, and Emily Bender. 2003. *Syntactic Theory: A formal introduction*. Second edition. Stanford: CSLI Publications.

Searle, John. 1969. *Speech Acts*. Cambridge MA: Cambridge University Press. <https://doi.org/10.1017/CBO9781139173438>

Robert Stalnaker. 1978. Assertion, *Syntax and Semantics 9*, New York: Academic Press, 1978. Reprinted in Robert Stalnaker, *Context and Content*, Oxford: Oxford University Press 1999, 78-95.

Stalnaker, Robert C. 1998. *On the representation of context*. *Journal of Logic, Language, and Information*, 7, 1998. Reprinted in Stalnaker, 1999.

Stalnaker, Robert C. 1999a. *Context and Content*. Oxford: Oxford University Press. <https://doi.org/10.1093/0198237073.001.0001>

Stalnaker, Robert C. 1999b. Introduction. In *Context and Content*. Oxford: Oxford University Press. <https://doi.org/10.1093/0198237073.003.0001>

Traum, David R. 1999. Speech Acts for dialog agents. In Woodrife, M. and A. Rao. *Foundations of Rational Agency*. 169–201. Kluwer.

Van Valin, Robert D. 2005. *Exploring the Syntax-Semantics Interface*. Cambridge MA: Cambridge University Press <https://doi.org/10.1017/CBO9780511610578>