# Formal Ontology for Discourse Analysis of a Corpus of Court Interpreting

Adam Pease[1], Jennifer Cheung Pease[2] and Andrew K.F. Cheung[3]

Infosys/ Freelance translator interpreter/ Hong Kong Polytechnic University

**Abstract.** We develop a new method of discourse analysis using speech act theory and formal ontology. The method constitutes effort to make discourse analysis more formal and repeatable. We apply the method to a corpus of bi-lingual, interpreted legal dialogue. We focus on the speech act of clarification and its component acts. While discourse analysis is primarily a qualitative tool, it can be applied quantitatively by counting certain types of discourse, such as clarification speech acts. Dialogues are still analyzed, utterances are classified as speech acts and their semantic relationships are qualitatively assessed. Subjectivity of human analysis is minimized using a new method of discourse analysis that employs a formal ontology. The ontology is stated in higher-order logic making the annotation of the corpus more objective, formal and repeatable than prior research.

**Keywords**: court interpreting, ontology, corpus, Hong Kong

## 1. Problem Statement

While discursive and anecdotal analysis of discourse can be useful for guiding future research, quantitative, formal and objective methods are typically the basis for repeatable scientific studies in most disciplines. Work in corpus linguistics involving natural language processing has made great advances possible in the study of language. However, NLP has not advanced to the point of complete machine understanding of arbitrary text.

To address a quantitative and repeatable method for analyzing text above the level of lexicon and word semantics, we need an approach that utilizes both human skill and machine processing. In our work, we use mathematical logic to specify aspects of pragmatics in a rigorous way, theorem proving to ensure that the logic is free of contradictions, and human annotation to label text with terms from the logic.

Our work at present targets clarification speech acts in interpreting discourse. Though dialogues are still analyzed, utterances classified as speech acts and their semantic relationships can be quantitatively assessed. Subjectivity of human analysis can be minimized using a formal logical theory, and in this effort the Suggested Upper Merged Ontology (SUMO) (Pease, 2011; Niles and Pease, 2001) is be used. Formal definition in logic can help make discourse analysis objective, testable and thus enable further generalization.

While in this article we focus on the technical aspects of the ontology, we will also provide description of the legal corpus and process of annotation.

### 1.1 Application Domain

In applying our method of ontology-based discourse analysis, we look at clarification speech acts in a bi-lingual, interpreted courtroom dialog. We attempt to quantify partiality in translation through this method. A few recent examples of research in court interpreting have touched on the importance of clarification in the interpreter-mediated courtroom. Some research has used empirical data from transcripts of court proceedings, and suggested that

the interpreters have latitude in deciding whether or not to seek clarification. This may affect the accuracy and partiality of their rendition (Jacobsen, 2004; Hale, 2004; Lee, 2009a; Lee, 2009b; Lee, 2013; Morris, 1995; Nakane, 2009). Often, conclusions are drawn using comparative analysis on a parallel corpus of a handful of highly selective data from tens of hours of recordings of multiple court cases. No attempt has previously been made to provide an examination of the landscape of clarification at the communication level, nor to provide statistics of clarifications in a courtroom setting. Clarification has not previously been defined in discourse analysis, making it hard to compare findings from different researchers coming from different languages, culture and legal systems.

Previous authors (Hertog, 2013) have commented that much research in court interpreting is descriptive and qualitative and is often prone to quick generalization with little opportunity for experimental and quantitative analysis. Research using discourse analysis and pragmatics has shown the potential impact of strategies used by the interpreters on the accuracy and partiality of their rendition of the testimony given by the witness. However, little statistical information has been given on their data, leaving us to guess how often this deviation from their invisible mode happens and how extensive the impact is.

## 2. Prospective Applications

### 2.1 Translation Gap Analysis and Chunking

Prior work in chunking (Katan, 2004) has been conducted for analysis and improvement of the performance of simultaneous interpreting. A neutral third language might also be used to capture the semantics of chunks. Identifying and quantifying chunks in translation provides one possible measurement technique for translation gap analysis.

Language is a conduit for thought (Reddy, 1979). Language is the medium through which thoughts are communicated, not the thoughts themselves. Translation renders this even more apparent. We see potential application for ontology in characterizing gaps in translation. Characterizing gaps in translation between two languages has the challenge that expressing a gap requires some language, and typically one of the two languages involved has been the medium of expression. However, that necessarily biases the expression toward one language or the other. Toury (2012) discusses the notion of an invariant third text. Gaps can include lexical gaps and conceptual gaps that result from the imperfect translation of complex concepts. Having a logical language that can express the union of the semantics of utterances in two languages is a potential such text. The challenge to date has been in finding a logical language and set of defined terms expressive and comprehensive enough to encompass the semantics of natural language. SUMO provides a reasonably robust candidate resource for such an approach. Encoding gaps in a logical language, grouping them into chunks and then quantifying the chunks is one possible objective approach to translation gap analysis.

### 2.2 Objectives

The application of this method is to carry out a quantitative analysis on clarification discourse in interpreter-mediated court proceedings in Hong Kong, to answer the question of what constitutes clarification. If we know which speakers are predominately the ones asking for clarification, we can objectively state whether the interpreter is partial. For example, if the interpreter were only to clarify utterances from the witness or defendant, seldom clarifying utterances from the lawyers or the judge, then the interpreter would be demonstrating partiality. Additionally, if we can classify the reasons for clarification, we

could further collect the metrics for such bias, explaining where and how it occurs. We can grade an interpreter's clarification on a continuity scale of visibility and partiality adopting Angelelli's text ownership approach (Angelelli, 2004). Knowing the typical clarification pattern of professional court interpreters can help us establish clarification metrics. The magnitude of visibility and partiality metrics on clarification acts can indicate which acts are frequently observed with little ramification, and which indicate high text ownership of the interpreter, showing subjectivity in his opinion or bias. Clarifications of this sort should be avoided in the context of court interpreting. This information could aid the education of professional court interpreters to help remove bias and further facilitate communication.

In our method we combine the concepts of Turn-taking and Repair from Conversation Analysis (Sacks et al., 1974; Schegloff and Sacks, 1977) and Speech Act Theory (Austin, 1962; Searle, 1969) with a formal ontology. This work is distinct from previous research (Hale, 2004; Lee, 2009a, b, 2013) where their findings are subject to interpretation, because their definitions of what constitutes clarifications are not sufficiently objective and formal. This may allow biased conclusions to be drawn, whether intentionally or unintentionally, putting the validity of research at stake. Defining speech acts in terms of formal logic (Jurafsky and Martin, 2009) such as the Suggested Upper Merged Ontology (SUMO) (Niles and Pease, 2001; Pease, 2011), can minimize such bias. Each SUMO definition is stated in an expressive mathematical logic (Pease, 2009) and therefore not susceptible to arguments about linguistic intuitions. Conflicts in meaning can be resolved by simply referring to a set of precise logical axioms. Those axioms themselves can be proven consistent with each other and a large body of facts known about the world which are contained in SUMO. These proofs are done by automatic theorem proving on a computer (Sutcliffe and Suttner, 2006; Pease et al., 2010). In contrast, traditional informal definitions stated in English or another human language must rely on a fallible human and his or her intuitions about linguistic definitions to ensure correctness and consistency. As a result, the counting and analysis based on SUMO is more objective, making this research method more scientific and replicable. Though it may appear to be just a means to an end, there is a long history of methods themselves being the subject of research such as Critical Discourse Analysis (Fairclough, 1995) and Conversation Analysis (Sacks et al., 1974).

The two objectives are reciprocal, with the application validating the operability and feasibility of the formalized discourse markup method and the method validating the hypotheses in the application. Classifying and counting the occurrences of clarification speech acts in a corpus of transcripts of court cases is one such application. The findings will add to our knowledge and theoretical understanding of the speech acts used for clarifications, setting the ground work for further objective discourse analysis.

## 2.3 Speech Act Theory

An utterance is an act people use to get things done. It can be analyzed in three levels: locutionary, illocutionary and perlocutionary (Austin, 1962). The locutionary level refers to the literal meaning of the utterance; the illocutionary level is the intention of the speaker of the utterance; and the perlocutionary level is the effect the utterance on the hearer. Searle further refined Austin's ideas by defining a speech act as its illocutionary force in terms of a set of rules (Searle, 1969). The content of a speech act carries a force. An utterance, according to Searle, may be analyzed into two components: its content and illocutionary force.

He defined illocutionary force in terms of features, such illocutionary force indicating devices (IFIDs) as performative verbs, word order, stress, intonation contour, punctuation,

the mood of the verbs etc. Such verbs include request, assert, state, question, thank etc., which Searle claimed to be over a thousand in English.

The content together with the mood of the sentence also add strength to the force. The propositional content of the utterance, together with a set of conditions, which Searle called constitutive rules, define each speech act. They are the preparatory condition, essential condition and sincerity condition. However, Searle did not provide logical definitions, or enumerate a comprehensive set of speech acts. This is the research we describe here.

## 2.4 Formalizing Speech Acts

Several attempts have been made to axiomatize aspects of speech act theory and produce an algebra of illocutionary forces, acts, etc., in which certain results can be proven concerning the relation between acts, acts and intentions, as well as acts and contexts. Researchers in artificial intelligence have based their formalizations on the concepts of plans, goals, intentions, and beliefs, attempting to come up with some of the basic features of speech acts from these primitive concepts. These include (James F. Allen, 1980; Cohen and Levesque, 1990), and the numerous articles cited in those two works. (Searle and Vanderveken, 1985) on the other hand, present a straightforward formalization of the informal ideas of Searle, with the idea of demonstrating the consistency and completeness of those ideas.

## 3. Suggested Upper Merged Ontology

A more objective method is to define speech acts in terms of a formal ontology. In this work, we use the Suggested Upper Merged Ontology (SUMO) (Niles and Pease, 2001; Pease, 2011). SUMO is a common sense theory of the world, as opposed to some minimum set of logical expressions taken out of context of the larger body of common sense.

The Suggested Upper Merged Ontology (Niles and Pease, 2001; Pease, 2011) began as just an upper level ontology encoded in first order logic. The logic has expanded to include higher order elements. SUMO itself is now a bit of a misnomer as it refers to a combined set of theories: (1) the original upper level, consisting of roughly 1,000 terms, 4,000 axioms and some 750 rules. (2) A Mid Level Ontology (MILO) of several thousand additional terms and axioms that define them, covering knowledge that is less general than those in the upper level. We should note that there is no objective standard for what should be considered upper level or not. (3) There are also a few dozen domain ontologies on various topics including theories of economy, geography, finance and computing. Together, all ontologies total roughly 20,000 terms and 80,000 axioms. There are also an increasing group of ontologies which are theories that consist largely of ground facts, semi-automatically created from other sources and aligned with SUMO. These include YAGO (de Melo et al., 2008), which is the largest of these sorts of resources and has millions of facts.

SUMO is defined in the Standard Upper Ontology Knowledge Interchange Format (SUO-KIF) [4] , which is a derivative of the original KIF (Genesereth, 1991). SUMO proper has a significant set of manually created language display templates that allow terms and definitions to be paraphrased in various natural languages. These include Arabic, French, English, Czech, Tagalog, German, Italian, Hindi, Romanian, and Chinese (traditional and simplified characters).

SUMO has been mapped by hand to the entire WordNet lexicon (Niles and Pease, 2003), and to the 22 languages of The Open Multilingual Wordnet (OMW)[5] (Bond et al. 2014).

## 4. Conceptual Framework

### 4.1 Quantifying Clarification Dialogues in Terms of Repair Turns and Speech Acts

We use a SUMO-based formalization of speech acts which is roughly in line with Searle's speech acts. They include classification of the context and framing of the utterance. Clarification is defined precisely by enumerating its specializations. It consists of a number of speech acts, including but not limited to requesting, responding, elaborating, restating, questioning, disagreeing, correcting, confirming etc. We define clarification using formal ontology in which each act is defined mathematically in logic, rather than only in a human-readable natural language.

**Clarification as Repairs** A clarification is a repair attempt (Sacks et al., 1974) that refers in some sense to a previous utterance and either subsumes or overlaps its semantic content, in plain terms, providing a new statement that corrects an error or communicates the original idea more clearly in terms more easily understood by the listener of the original message. It can be seen as a meta-dialogue within the overall dialogue of the question and answer mode of the courtroom proceeding, with turn being the basic unit of analysis. A clarification may consist of only one turn or multiple turns, depending on whether it is initiated by the original speaker (self-initiated) in one turn to correct or rephrase what was said in the previous turn; or initiated by another party (other-initiated) to request further elaboration of the previous turn of the original speaker. An other-initiated clarification typically pairs with a response from the original speaker, and may or may not follow by a feedback from the person requesting the clarification. Depending on the number of participants involved and the complexity of the issues involved, a clarification may span to multiple turns.

**Clarification Speech Acts** Each clarification turn in this study is then further analyzed into speech acts based on both the pragmatics and semantics of the turn, allowing multiple speech acts per turn. For example, a turn requesting clarification may consist of a speech act of questioning and elaborating, while a responding turn may consist of answering, correcting and apologizing. In doing so, the clarification dialogues are reduced to quantifiable logical units, allowing the frequency and pattern of clarification to be measured in terms of turns and speech acts with respect to its initiator and respondent, the language used, and the reason for the clarification, paving way for more objective statistical analysis, that gives us a better understanding of the size and representativeness of the empirical data. Meaningful statistics can be derived by collecting the information proposed to be annotated in each clarification turn. For example, we can compare the total number of turns with the clarification turns to find out the frequency of clarification in the proceeding, and the percentage of the interpreter's involvement in the clarification dialogues.

By focusing on the clarification dialogues of the interpreter-mediated court proceedings, we can examine the factors that impinge on classification dialogues. These include power relationships (Hale, 2004; Mason and Ren, 2012; Kaufman, 2006), language-dependent inexplicitness (Lee, 2009a; Cheung, 2012), issues arising from cross-linguistic and cross-cultural communication (Lee, 2009b), interpreter's face work in the courtroom (Lee, 2013; Yuan, 2013), and distracting features often missed by interpreters (Gile, 1999). A more objective counting and analytical method of discourse analysis can be achieved, by addressing clarification discourse as turns in meta-dialogues within the global dialogue, and defining each clarification turn in terms of speech acts with a formal ontology.

### 4.2 Clarification Speech Acts in SUMO Definition

Clarification addresses a communication act. It can be from one's self or by others. It can be initiated in the speech acts of requesting, questioning, prompting, elaborating, restating, correcting and apologizing. It can be responded to in the speech acts of restating, elaborating, answering, correcting, confirming, apologizing, and thanking. These precise terms are defined in SUMO. A diagram of the taxonomic structure of these terms is shown in Figure 1. Explanation of the definitions of the most relevant terms is given in section 6 Definitions, below.

```
Communication
  LinguisticCommunication
    Speaking
    Stating
      Disagreeing
      Registering
      Answering
      Arguing
      Pleading
      Testifying
      Apologizing
      Confirming
      Correcting
      ReachingAgreement
    Supposing
    Directing
      Ordering
      Requesting
        Reminding
        Prompting
      Questioning
    Committing
      Offering
      Threatening
      ClosingContract
      Reserving
      SigningAnAgreement
    Declaring
      LegalDecision
        LegalAward
        LegalConviction
        LegalDismissal
        LegalAquittal
        Sentencing
      Naming
      Founding
      Accrediting
      Divorcing
      Appointing
      Wedding
  WrittenCommunication
    Emailing
  Corresponding
```

```
    TellingALie
    ExpressingInLanguage
      Thanking
    Debating
    Negotiating
    Elaborating
    Restating
```

**Fig. 1.** Subclass hierarchy of `Communication` types

### Speech Acts of Clarification Dialogue

In reviewing the court transcripts, created a number of concept types that were associated with clarification acts. They can be classified into `Questioning, Answering, Elaborating, Confirming, Restating and Correcting`. Each speech act is formalized in terms of SUMO.

For example, `Correcting` in SUMO is defined as "a part (`subProcess`) of a `Disagreeing` (variable `?D`) in which the speaker explicitly refers to a prior statement", with the following axiom shown in figure 2.

```
(=>
  (instance ?C Correcting)
  (exists (?D ?S ?SP ?CP)
    (and
      (instance ?D Disagreeing)
      (subProcess ?C ?D)
      (instance ?S Stating)
      (containsInformation ?S ?SP)
      (containsInformation ?C ?CP)
      (refers ?CP ?SP)
      (not
        (consistent ?CS ?SP)))))
```

**Fig. 2**. An axiom for `Correcting`

In this axiom, the information to be corrected (variable `?CP`) is not consistent with what was given (variable `?SP`) in the previous statement. A full definition of each term can be found on-line[6]. The advantage of a formal definition is that it specifies concerns such as this precisely, so that there is no argument about linguistic intuitions, and to resolve issues about meaning one can simply refer to a set of precise logical axioms. With this definition in place, the markup analyst can refer to the correspondent formal definition when seemingly identical or conflicting situations occur in the process of classification. This ensures a more consistent and objective markup. Definitions made this way can be reused because SUMO is open-source and language independent, and it therefore supports objective statistics about the number and kind of clarification dialogues.

### 4.3 Definition of Clarification Dialogue Set

A clarification is defined as an utterance that refers in some sense to a previous utterance and either subsumes or overlaps its semantic content, in plain terms, providing a new statement that corrects an error or communicates the original idea more clearly in terms more easily

understood by the listener of the original message. Markup starts from the initiation of the clarification. It can be as few as one turn when the speaker only performs a self-clarification, or as many as ten turns when the dialogues involve multiple speakers with responses and in which the original speaker gives his or her feedback. The boundary of each clarification set does not hinge on the speech or the person but on the content of the clarification. It is considered to be a unit of clarification when the dialogues end with no further discussion on the same topic. We mark up the clarification dialogues as a sequence of turns which start with an initiation. It can be either initiated by the speaker of the previous utterance or by the hearer regarding the previous utterance.

## 4.4 Original Turn Number and Splitting Turn

Each turn is given a number. This number is reset every session. This number is kept in the markup but an alphabetical suffix is added to the turn number of the clarification dialogue when an occasion for a split-turn is identified (see Figure 3). Split-turns occur when the speaker addresses two separate targets sequentially in one turn. As the turn is our minimum unit of analysis, to distinguish the target of each turn clearly, it is sometimes necessary to split the turns. The final alphabetic character is used to sub-label the turn without changing the sequence of the original turn.

| Turn | Speaker | Content |
|------|---------|---------|
| 187 | JE | you said fifty |
| 188 | IE | [voices overlapped] |
| 189a | BDE | [voices overlapped] no problem not fifteen fifty my lord (unintelligible) |
| 189b | BDE | you met some SIX years old to FIFTY years old is that right |
| 190 | ICT | 你所指係話你教過學生呢就係界乎呢六歲至到五十歲 |
| 191 | DC | 係冇錯 |
| 192 | IET | yes |
| 193 | JE | ye |

**Fig. 3**. An example of the split-turn

## 4.5 Speakers of the Turn

Speakers in the turn are abbreviated to identify their role. They are divided into the prosecutor, defense lawyers, judge, interpreter, defendant and witness. Their utterances are further divided into Cantonese or English.

## 4.6 Agent vs Patient

SUMO process attributes are used to represent the "speaker" and "target" of clarification respectively. The agent of a turn can be recovered by straightforwardly copying the speaker from the transcript, while the target will have to be determined by the markup analysis by considering the Utterance within its context.

## 4.7 Language

The language in the turn is separated out from the transcript. There are two ways to confirm the language. First, it is just by looking at the utterance itself. Second it can be inferred from the abbreviation symbol used for the speaker, where a "C" suffix means Cantonese and an "E" suffix denotes English.

## 4.8 Speech Acts

Initially, nine speech acts were identified as clarification speech acts. They are: answering, apologizing, confirming, correcting, disagreeing, elaborating, questioning, requesting, restating. Later, it was found that there was a need to further refine the directives to include ordering, prompting and reminding. In a more complex clarification situation, stating and reaching agreement are also found. Thanking is added as an expressive. All together, there are 15 speech acts are defined in this markup. They are all formally defined in SUMO. Speech act markup for each turn is determined using the SUMO definition. Multiple inherence of speech acts are allowed for each turn, meaning more than one speech act class may be marked for each instance of a speech act in a turn. The SUMO definitions have proven to be extremely useful when there is a borderline situation.

## 5. Pilot Study

An online corpus, called "From legislation to translation, from translation to interpretation: The Narrative of Sexual Offences" (Leung, 2005) is used for the study. It is an 800,000 word bilingual verbatim transcript of 101 audio-tapes of the proceedings of examinations and cross-examinations by counsels in five separate rape trials. All of the trials were heard with the presence of interpreters in the High Court of Hong Kong. This corpus is an open and free empirical data source. It is a semi-structured corpus in spreadsheet format.

This trial project entails marking up clarification discourse of the bilingual verbatim transcript from the first case out of five separate rape trails from the online corpus[7] . It contains slightly over 11,000 turns of dialogue. The transcript is divided into hearings for defendant and witness separately. There are 11 sessions for the defendant and 6 sessions for the witness. Each session was transcribed into turns of utterance, which contains a turn number, the identity of the speaker and its content.

### 5.1 Discussion

This section describes how frequency and pattern of clarification dialogues reflect the role of the Judge, the questioning lawyer and the interpreter. Then we study interpreters' clarification pattern and their reasons to if they can give us any hinds of interpreting issues such as inaccuracy, partiality. Some observations on improvement on current method are also discussed.

### 5.2 Special Discourse in the Courtroom

When is a judge's request an order? This may sound a philosophical question but it has actual bearing on the markup. Since the judge has the highest power in the courtroom, he must determine the course of the hearing in consideration of fairness to both sides. From time to time, he will need to issue a forceful command which is distinguished from his ordinary requests. It is for this reason that we added the speech act of ordering to differentiate his intention and the impact it has on the other participants. In Figure 4, the judge asked the defendant to confirm his understanding in turn 102, but the interpreter took it to himself to answer the judge in turn 103 by repeating the translation. This is obviously not what the judge wanted, so he reissues his request, this time in an order in turn 104 to make it known to the interpreter that he is to translate his question, instead of answering the question for the defendant. The judge might have given his order with some kind of facial gestures which is unavailable to us in the transcript, but the context has pointed us that this is an order instead of a request.

| Turn | Speaker | Content | Speech Act |
|------|---------|---------|------------|
| 102 | JE | so you've never gone to the location she men | Questioning |
| 103 | IET | which she mentioned the incident happened | Answering, Restating |
| 104a | JE | so you never went to that place is that correct? | Restating, Ordering, Questioning |
| 105 | ICT | 換言之你意思係話你從來冇去過個地方係咪啊 | Translation |
| 106 | DC | 冇 | Confirming |
| 107 | IET | right | Translation |

**Fig. 4.** An example of the Speech Act of **Ordering** Issued by the Judge

It is interesting to look further at the reason of clarification by the judge in future work. For example, what are the major reasons for his clarifications? Does each reason for clarification observe his role as the presiding judge? What other special features can we observe from his clarification pattern? The judge posted most frequent number of spontaneous initiations of clarification requests. This category has a high visibility rating and it also contains reasons that may not be inferred from the dialogue. As the analysis of the clarification dialogues concern more repairs within the dialogue, we may not have the perspective of the judge who is overseeing the trial from the angle of jurisdiction. The other reasons for the judge's clarifications are "word meaning", "cannot hear" and "information gap", which rank medium in terms of visibility.

## 5.3 How Formalized Speech Acts Help Defining Clarification Dialogues

It may appear easy to identify a clarification in a few exchanges, but keeping the definition consistent, is not that straightforward, especially when the dialogue involves multiple participants with interwoven translation, and spanning over sessions of back and forth arguments in the form of questions and answers. Looking at the semantics of the exchanges on its own can be confusing and it is not enough to define the boundary of clarification turns. The following example (figure 5) shows how analyzing the pragmatics in terms of the intention of the speaker in speech acts help us define this as a clarification dialogue.

Here, the prosecutor initiates a request to the interpreter to repeat the translation. In response, the interpreter repeats the translation. The prosecutor then repeats the last word "high" to make sure he has heard it correctly, followed by the interpreter's confirmation.

| Turn | Speaker | Content | Speech Act |
|------|---------|---------|------------|
| 624 | IET | then he asked me if I felt high | |
| 625 | BPE | Sorry | Requesting |
| 626 | IE | he asked me if I felt high | Restating |
| 627 | BPE | high | Restating |
| 628 | IE | yes | Confirming |

**Fig. 5.** Defining clarification in terms of Speech Acts

## 5.4 When Sorry is not an Apology

The above example also shows us how the formal definition of the speech act of apologizing help us avoid mistakes in the markup. Typically, one would mark turn 625 as a speech act of apology on seeing the word "sorry". But having a formal definition helps to avoid this trap because apology has been defined as "The speaker states that some action he or she took previously was wrong in some way, that it caused harm to the hearer" in SUMO (Figure 6).

```
(=>
  (and
    (instance ?A Apologizing)
    (agent ?A ?AG)
    (destination ?A ?P))
  (exists (?ACT)
    (and
      (suffers ?ACT ?P)
      (earlier ?ACT ?A)
      (agent ?ACT ?AG)
     (holdsDuring
       (WhenFn ?A)
       (not
         (wants ?AG ?ACT))))))
```

**Fig. 6**. An axiom for `Apologizing`

If there is no indication in the dialogue of such condition, we can safely rule it out as being an act of apology and determine it to be a request for the speaker to repeat what was said previously. The utility of defining speech acts in SUMO does not end here. Because SUMO is open source, other researchers can use the same set of definitions on their data set, opening opportunities for collaboration. This could help make research more comparable and the claims and findings more verifiable. Having the definition given in SUMO code extends its application to non-English based research community. All the axioms are language independent and can be presented automatically several different languages, which allows the same hypotheses about linguistic semantics to be tested on different languages and cultures.

### 5.5 How to Handle Tacit Consent

Some may argue that defining speech acts purely on a transcript is not sufficient to handle contextual clues such as intonation and facial or body gestures. It is true that non-verbal communication may be lost in the transcript. However, if we keep our analysis consistent, with a rule which we may follow is that if there is a request, followed by smooth non-contentious dialogue, and no explicit response to the request, then we assume some sort of non-verbal communication has occurred, and that we therefore assume it to be a "tacit consent" (figure 7).

| Turn | Speaker | Content | Speech Act |
|------|---------|---------|------------|
| 657 | IET | at about five pm in the evening earlier on we had had an appointment with five or six other people to play badminton | |
| 658 | BPE | sorry ah y | |
| 659 | IC | 打網球啊 | Restating |
| 660 | IET | to play badminton | |

**Fig. 7**. An example of "tacit consent"

### 5.6 Borderline Clarification Endeavours

Other subtle but actual endeavours of clarification, such as self-initiated clarification or a one-liner clarification made on the other speaker, can also be included in the analysis. Here is an example of a self-clarification (figure 8) made by the prosecutor in turn 752 by elaborating, which was further modified by the judge in turn 753 also in an elaborating speech act before it was translated to the witness in 754.

| Turn | Speaker | Content |
|---|---|---|
| 750 | BPE | i-is it right from what you said that you remember the FIRST time that being fairly early in the holiday period |
| 751 | ICT | 咁而妳所指 |
| 752 | BPE | well it doesn't take a genius to work out that the next time was one or two months later that the first time must have been early in the holiday period |
| 753 | JE | was the first time quite early on in the holiday period |
| 754 | ICT | 第一次發生事時候呢係咪響妳放暑假好早好早期時 |

**Fig. 8**. Defining Borderline Case Clarification Dialogues

One may argue that these are borderline cases and can be dismissed from the analysis. But what matters here is to keep a consistent analysis. Again, this can only be achieved by having a clear and well-documented set of rules and definitions.

### 5.7 Redefine `Elaborating` in SUMO

Initially, `Elaborating` was mapped as a sub-process of `Stating` in SUMO, making it incompatible with `Questioning`. But during the markup, we found that it can be better classified as a subset of a broader linguistic communication class than just Stating, thus its axiom is redefined and mapped out of the process of stating in SUMO. This allows the use of `Elaborating` in the sense of elaborating a question.

```
(subclass Elaborating LinguisticCommunication)

(=>
  (instance ?E Elaborating)
  (exists (?L ?EP ?LP)
    (and
      (instance ?L LinguisticCommunication)
      (earlier ?L ?E)
      (containsInformation ?E ?EP)
      (containsInformation ?L ?LP)
      (subsumesContentInstance ?EP ?LP))))
```

**Fig. 9**. `Elaborating`

### 6. Definitions

Let's now examine each of the Speech Act terms and their definitions in more detail (see figures 10 to 22). Each term used in every axiom is defined in turn with its own set of axioms. We will not be able to provide all those supporting definitions here, but refer the reader to the content posted on line at **http://www.ontologyportal.org**. We have described **Apologizing** and **Elaborating** above. We also will not have space to discuss every axiom provided for each Speech Act, but only discuss the most salient ones.

```
(=>
  (instance ?ANSWER Answering)
  (exists (?QUESTION)
    (and
```

```
      (instance ?QUESTION Questioning)
      (refers ?ANSWER ?QUESTION)
      (earlier
         (WhenFn ?QUESTION)
         (WhenFn ?ANSWER)))))
```

**Fig 1**0. `Answering` consists necessary of responding to a `Questioning` that has
happened earlier in time. It must refer explicitly to the particular `Questioning`.

```
(=>
  (and
     (instance ?C Confirming)
     (agent ?C ?A)
     (containsInformation ?C ?P))
  (exists (?S ?RA ?A2)
     (and
        (instance ?S Stating)
        (earlier ?S ?C)
        (instance ?RA ReachingAgreement)
        (agent ?S ?A2)
        (containsInformation ?RA ?P)
        (containsInformation ?S ?P)
        (partyToAgreement ?RA ?A)
        (partyToAgreement ?RA ?A2))))
```

**Fig 11.** `Confirming` is a `Stating` in which the speaker is part of a
`ReachingAgreement` and in which the `Proposition` under consideration has already
been stated. The `Stating` and the `ReachingAgreement` contain the same information.
The `Stating` must occur earlier than the `ReachingAgreement`.

```
(=>
  (instance ?C Correcting)
  (exists (?D ?S ?SP ?CP)
     (and
        (instance ?D Disagreeing)
        (subProcess ?C ?D)
        (instance ?S Stating)
        (earlier ?S ?C)
        (containsInformation ?S ?SP)
        (containsInformation ?C ?CP)
        (refers ?CP ?SP)
           (not
              (consistent ?CS ?SP)))))
```

**Fig 12.** A `Correcting` is a part of a `Disagreeing` in which the speaker refers to a prior
statement. The `Correcting` contains information that entails a logical contradiction to
some information contained in a previous `Stating`.

```
(=>
  (instance ?DIS Disagreeing)
  (exists (?A1 ?A2 ?STATE1 ?STATE2 ?STMT1 ?STMT2)
    (and
      (subProcess ?STATE1 ?DIS)
      (subProcess ?STATE2 ?DIS)
      (agent ?STATE1 ?A1)
      (agent ?STATE2 ?A2)
      (not
        (equal ?A1 ?A2))
      (containsInformation ?STATE1 ?STMT1
      (containsInformation ?STATE2 ?STMT2)
      (not
        (consistent ?STMT1 ?STMT2)))))
```

**Fig 13.** A `Disagreeing` is a `Stating` in which two `Agents` have contradictory statements. Note that unlike a `Correcting`, the statements need not explicitly refer to one another

```
(=>
  (and
    (instance ?ORDER Ordering)
    (patient ?ORDER ?FORMULA))
  (modalAttribute ?FORMULA Obligation))
(=>
  (and
    (instance ?ORDER Ordering)
    (result ?ORDER ?SENTENCE)
    (instance ?SENTENCE Sentence))
  (instance ?SENTENCE Order))
```

Fig 14. `Ordering` is a `Directing` in which the receiver is commanded to realize the content of a `ContentBearingObject`. Orders are injunctions, the disobedience of which involves sanctions, or which express an obligation upon the part of the orderee.

```
(=>
  (instance ?P Prompting)
  (exists (?H ?A)
    (and
      (destination ?P ?H)
      (agent ?P ?A)
      (desires ?A
        (exists (?LC)
          (and
            (instance ?LC LinguisticCommunication)
            (agent ?LC ?H)
            (earlier ?P ?LC)
            (subsumesContentInstance ?LC ?P)))))))
```

**Fig 15. Prompting** is an implied sort of **Requesting**, in which the speaker begins an utterance, asking the hearer to complete it.

```
(=>
  (and
    (instance ?QUESTION Questioning)
    (agent ?QUESTION ?AGENT)
    (patient ?QUESTION ?FORMULA)
    (instance ?FORMULA Formula))
  (holdsDuring
    (WhenFn ?QUESTION)
    (not
      (knows ?AGENT ?FORMULA))))

(=>
  (and
    (instance ?QUESTION Questioning)
    (result ?QUESTION ?SENTENCE)
    (instance ?SENTENCE Sentence))
  (instance ?SENTENCE Question))
```

**Fig 16. Questioning** is a request for information. A **Questioning** results in a **Question**. Note that there is no a priori necessity that the question be answered. Note also that this is a genuine question where the speaker does not know the answer.

```
(=>
  (and
    (instance ?RA ReachingAgreement)
    (agent ?RA ?AGENT)
    (result ?RA ?PROP)
    (instance ?PROP Agreement))
  (holdsDuring
    (FutureFn
      (WhenFn ?RA))
    (partyToAgreement ?AGENT ?PROP)))

(=>
  (instance ?RA ReachingAgreement)
  (exists (?A1 ?A2)
    (and
      (agent ?RA ?A1)
      (agent ?RA ?A2)
      (not
        (equal ?A1 ?A2)))))

(=>
  (instance ?RA ReachingAgreement)
  (exists (?PROP)
    (and
```

```
        (instance ?PROP Agreement)
        (result ?RA ?PROP))))
```

**Fig 17.** `ReachingAgreement` is a `Stating` in which two or more agents affirm the same thing (acknowledge the truth of the same `Proposition`s). Contrast this definition with `Disagreeing`.

```
(=>
  (instance ?REMIND Reminding)
  (exists (?REMEMBER)
    (and
       (instance ?REMEMBER Remembering)
       (causes ?REMIND ?REMEMBER))))
```

**Fig 18.** `Reminding` is a `Requesting` that is intended to cause a `Remembering` of something.

```
(=>
  (and
     (instance ?REQUEST Requesting)
     (agent ?REQUEST ?AGENT)
     (patient ?REQUEST ?FORMULA)
     instance ?FORMULA Formula))
  (desires ?AGENT ?FORMULA))

(=>
  (and
     (instance ?REQUEST Requesting)
     (result ?REQUEST ?SENTENCE)
     (instance ?SENTENCE Sentence))
  (instance ?SENTENCE Request))
```

**Fig 19.** `Requesting` is a request that expresses a desire that some future action be performed.

```
(=>
  (instance ?R Restating)
  (exists (?L)
    (and
       (instance ?L LinguisticCommunication)
       (earlier ?L ?R)
       (containsInformation ?E ?RP)
       (containsInformation ?L ?LP)
       (equivalentContentInstance ?RP ?LP))))
```

**Fig 20.** `Restating` is a `Communication` act in which the speaker reiterates the same `Proposition` as a previous speech act, without committing to the truth of what is said.

```
(=>
  (and
    (instance ?STATE Stating)
    (agent ?STATE ?AGENT)
    (patient ?STATE ?FORMULA)
    (instance ?FORMULA Formula))
  (holdsDuring
    (WhenFn ?STATE)
    (believes ?AGENT ?FORMULA)))
(=>
  (and
    (instance ?STATE Stating)
    (result ?STATE ?SENTENCE)
    (instance ?SENTENCE Sentence)
  (instance ?SENTENCE Statement))
```

**Fig 21.** A `Stating` commits the agent to some truth.

```
(=>
  (and
    (instance ?T Thanking)
    (destination ?T ?P))
  (instance ?P Human))
(=>
  (and
    (instance ?THANK Thanking)
    (agent ?THANK ?AGENT)
    (patient ?THANK ?THING)
    (destination ?THANK ?PERSON))
  (and
    (instance ?PERSON Human)
    (or
       (holdsDuring
         (WhenFn ?THANK)
         (wants ?AGENT ?THING))
       (holdsDuring
         (WhenFn ?THANK)
         (desires ?AGENT ?THING)))))
```

**Fig 22.** `Thanking` is an `ExpressingInLanguage` of appreciation to a person for something that the person did in the past.

## 7. Conclusion

In the pilot study of applying ontologically-based dialog markup, we have used a bottom-up approach to define clarification dialogues. In an attempt to propose a quantitative analysis to markup the clarification discourse which is a complicated concept, we defined clarification by enumerating its sub-classes, and give them a formal definition. The fact that SUMO is open and language independent make it an appropriate choice for an interoperable markup scheme. Observation from the initial data shows that clarification is inherently dialogic

rather than showing the characteristics of a single utterance. In the courtroom dialogue that we are studying, it is often a meta-dialogue involving multiple speakers and turns.

This pilot study also shows that we can focus on studying the clarification dialogue to analyze how imbalance of roles can affect the frequency and pattern of clarification in the interpreter-mediated courtroom.

The major issue with using quantitative analysis in discourse analysis is the problem associated with definition of the terms used in the markup, which are subject to interpretation. By employing ontology to define the terms formally, we can define and fix the boundary of the term and minimize errors caused by inconsistency associated with human interpretation.

We have discussed a formalized theory of Speech Acts, defined within a much larger, comprehensive ontology and shown how it can be applied in discourse analysis.

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[1] Adam Pease is a Principal Scientist at Infosys. Formerly, he was CEO and Principal Consultant of Articulate Software. He has led research in ontology, linguistics, and formal inference, including development of the Suggested Upper Merged Ontology (SUMO), the Controlled English to Logic Translation (CELT) system and the Sigma knowledge engineering environment. He is the author of the book *Ontology: A Practical Guide* and over 50-peer reviewed papers on NLP, ontology and logical inference.
Email: apease@articulatesoftware.com

[2] Jennifer L. F. Cheung Pease is a language scientist, translation and interpreting professional with a wide range of scientific and linguistic expertise in technology enterprises. She has conducted consecutive interpreting in tribunals in Hong Kong and simultaneous interpreting in international forums. Her latest project is to translate the documentation of SUMO into Chinese to make it more accessible to the Chinese community.
Email: jenniechhk@gmail.com

[3] Andrew K.F. Cheung is associate professor at the department of Chinese and Bilingual Studies, Hong Kong Polytechnic University. His research interests include corpus-based interpreting studies and quality perception of interpreting services.
Email: andrewkfcheung@gmail.com

[4] https://github.com/ontologyportal/sigmakee/blob/master/suo-kif.pdf

[5] http://compling.ntu.edu.sg/omw

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