

# On Dialogue Modelling, Language Processing Dynamics, and Linguistic Knowledge

Kempson, R., Gregoromichelaki,  
E.,  
King's College London  
ruth.kempson,  
eleni.gregor@kcl.ac.uk

Mills, G., Purver, M., Howes, C.,  
Healey, P.  
Queen Mary University of London  
gj, mp, ph, chrizba@dcs.qmul.  
ac.uk

With the ever-increasing work on context-dependence (DRT and many others since), work on *ellipsis* has inevitably come to join the ranks of core context-dependency phenomena. This has led to consequent growth of interest in dialogue, with its rampant display of *elliptical fragments*, structures that are essentially underspecified as regards the contribution they provide, needing fine-grained details of the dialogue context for their interpretation. In this talk, we argue that once the remit of linguistic explanation is expanded to include dialogue data, we need to adopt grammar formalisms that directly reflect the dynamics of incremental growth of interpretation. As we shall show with corpus and experimental data, conversational dialogue demonstrates that the model of *context* presumed in utterance processing needs to be incrementally evolving, structural, and even sensitive to the multiple patterns arising during the process of interpretation. Furthermore, the requisite concept of context must allow both input and output to comprise partial information, at any level, a requirement essential in the processing of *split utterances*: in dialogue, individuals frequently contribute to each other's utterances, with one party starting off with some partial idea in mind, to which some second may contribute some extension, reformulation or clarification, to which a third party may add some further contribution etc., the overall effect being some collective output which neither had envisaged at the outset of the conversational exchange. Such shift of speaker- and hearer- roles at arbitrary points, can notably occur across any syntactic or semantic dependency (see Purver et al 2009); and experimental/corpus data provides evidence that splits in utterances between parties in such exchanges, with take-over mid-sentence by an alternative participant, does not impede efficient communication and coordination between participants.

Split utterance phenomena are mysterious given conventional grammar formalisms with their sharp separation between static sentence-based grammar and language performance, the easy switch between supposedly separate models of parsing and production, in particular, being little short of perplexing. In contrast, *Dynamic Syntax* (DS, Kempson et al 2001; Cann et al 2005), in which "syntax" is defined as mechanisms licensing the progressive and incremental build up of interpretation, provides a natural and principled characterization of these phenomena. As we shall show, this result is achieved because, being a grammar formalism, hence presumed

to be used by speakers and hearers alike, the emergent model of dialogue involves very tight coordination of speaking and hearing: both parties are essentially carrying out the same activity of building up semantic representation in a radically context-dependent manner (see Kempson et al. 2009; Gregoromichelaki et al 2009).

With this novel perspective on what constitutes a grammar formalism and its application to dialogue modelling, we explore the claim that a *grammar* is a set of mechanisms for conversational interaction. But the way split utterances, and the interpretation of ellipsis in general, are handled in DS also leads to a radical shift in formal assumptions about the nature of communication. For what such data suggest is that success in communicative exchange does not require recognition of the content of the other parties' intentions as a sine-qua-non for communication. It rather relies on low-level but flexible linguistically-grounded mechanisms exploiting the rich structure of the context provided by the interactive exchange. This is an observation familiar for some time from *Conversation Analysis (CA)*, but which directly conflicts with all current assumptions about the nature of communication adopted by pragmatists in the Gricean tradition. However, in contrast to the CA methodology, it can be shown that the linguistic mechanisms underpinning the exchange have to enable structure to emerge as the outcome of the interaction, even in a single conversational exchange. In this talk, we will present experimental dialogue data using a novel chat-tool methodology (Healey et al 2003; Mills 2007) which illustrate this and the way it circumvents the need for mutual knowledge/common ground/intention computation.

The *chat tool* is an experimental resource for carrying out investigation of dialogue, allowing fine-grained interventions over the communicative features of the interaction. In maze-game experiments using the chat tool, participants communicate through a familiar text-based interface. However, instead of passing turns directly to the appropriate chat clients, each turn is routed via a server. This information can then be used to trigger specific experimental interventions. For example, a "spoof" clarification request might be issued that appears to originate from another participant. The recipient responds to the clarification, and the server produces an acknowledgement, neither of which are seen by the other participant. Subsequent turns are then transmitted as normal. It has been shown that this can be done without disruption to the dialogue or detection by the participants. This design provides data where it is demonstrated that the rich structure of the exchange guides interpretation and coordination, in particular in the domain of ellipsis. For example, in these exchanges, at late stages of the interaction between participants, sequences contract radically and become highly elliptical (*telescoping*). These sequences contain multiply ambiguous fragments which are interpreted by the participants differentially according to their position in the sequence. Such interpretations of fragments in the chat-tool data are diagnostic of the prevalent underspecification and plasticity of language that make it adaptable to novel situations. In this respect, semantic ontologies/interpretations arise during interaction rather than being given a priori (Healey & Mills 2006; Mills & Healey 2008; Healey 2008) through the association of words with *ad hoc concepts* (e.g. Carston 1998; Cooper & Ranta 2008; Larsson

2007; Bosch 2007) guided by the structured context. The latter consists of *routinised sequences*, modelled, in DS terms, as stored sets of actions and associations of word-actions pairs, as argued in Mills & Gregoromichelaki (in prep) (see also Pickering and Garrod 2004). Furthermore, these data also suggest that the sequential organization of the task provides interpretation of what the turn “is doing” without the need for guessing the other participant’s intention through metarepresentation of each other’s mental states/mutual knowledge or some separate, primitive notion of “joint intention” postulated a priori to guide coordination (cf Clark 1996). This conclusion is supported by the fact that explicit negotiation regarding plans, intentions, referential schemes etc. is more likely to interfere adversely at initial rounds of the maze-game (Mills 2007; Healey 2008) as participants have not yet figured out the structure of the task. Additionally, by inserting “spooof” clarification requests we can see from participants’ responses that they disambiguate significantly more frequently towards “intention”-based interpretation at late rounds as task experience increases (Mills 2007; Mills & Gregoromichelaki in prep). Hence we conclude that there is no necessary intention/common ground computation at work involving modelling the other’s perspective (even in task-specific dialogue) but, rather, the emergence of (routinised) structure guides efficient coordination. In this respect, the notion of “joint-intention” is derivative and emergent from the structure of conversation, rather than the basis of coordination.

The result is a much more direct feeding relation between linguistic knowledge and empirical data, with new questions and putative answers emerging. We suggest that, with language modelled as a mechanism for interaction in context, providing the means for each party to receive and provide feedback at any stage, success in communication is securable by ongoing incremental interaction, without any necessary hypotheses by either party in the exchange about the mental states of others (in line with work by Keysar et al 2000; Horton & Gerrig 2005; Pickering and Garrod 2004 etc.).

### References

- Bosch, P. (2007) “Productivity, Polysemy, and Predicate Identity”. In B. ten Cate & H. Zeevat (eds.) *Proceedings of the Sixth International Tbilisi Symposium on Language, Logic and Computation*. Springer. Heidelberg, Berlin. 2007. pp.58-71
- Carston, R (1998). *Thoughts and Utterances: The Pragmatics of Explicit Communication*. Blackwell, Oxford
- Cooper, R & Ranta, A (2008) “Natural languages as collections of resources” In: Cooper, R. and R. Kempson (eds) *Language in Flux: Relating Dialogue Coordination to Language Variation, Change and Evolution*. College Publications, London.
- Gregoromichelaki E, Y Sato, R Kempson, A Gargett, C Howes (2009) "Dialogue Modelling and the Remit of Core Grammar" In: *Proceedings of IWCS 2009*.
- Cann, R., Kempson, R., Marten, L. (2005) *The Dynamics of Language*. Elsevier, Oxford
- Cann, R., Kempson, R., Purver, M. (2007) “Context and well-formedness: the dynamics of ellipsis”. *Research on Language and Computation* 5(3), 333–358.

- Cann, R., Kempson, R., Purver, M.: Context and well-formedness: the dynamics of ellipsis. *Research on Language and Computation* 5(3), 333–358 (2007)
- Clark, H.H (1996). *Using Language*. Cambridge University Press
- Healey, P. (2008) Interactive misalignment: The role of repair in the development of group sub-languages. In: R. Cooper, R. Kempson (eds.) *Language in Flux*. College Publications, London.
- Healey, P. Purver, M. King, J. Ginzburg, J. and Mills, G. (2003). Experimenting with Clarification in Dialogue. In Proceedings of the 25th Annual Meeting of the Cognitive Science Society (CogSci 2003), Boston, MA.
- Healey, P., & Mills, G. (2006). “Participation, precedence and coordination in dialogue.” In: R. Sun & N. Miyake (eds.), Proceedings of the 28th Annual Conference of the Cognitive Science Society (pp. 1470–1475).
- Horton W S, Gerrig R J. (2005) “The impact of memory demands on audience design during language production” In: *Cognition* 96:127–142.
- Kempson, R., Meyer-Viol, W., Gabbay, D. (2001) *Dynamic Syntax: The Flow of Language Understanding*. Blackwell
- Kempson, R., Gregoromichelaki, E., Purver, M., Mills, G., Gargett, A., Howes, C. (2009) “How mechanistic can accounts of interaction be?” In: Proceedings of Diaholmia, the 13th SemDial
- Kempson, R., Gregoromichelaki, E., Sato, Y. (2009) Incrementality, speaker-hearer switching and the disambiguation challenge. In: Proceedings of SRSL 2009, pp. 74– 81. ACL.
- Keysar, B., Barr, D. J., Balin, J. A., & Brauner, J. S. (2000). “Taking perspective in conversation: the role of mutual knowledge in comprehension”. *Psychological Sciences*, 11, 32–38.
- Larsson, S (2007). Coordinating on ad-hoc semantic systems in dialogue. In Proceedings of the 10th SemDial.
- Mills G. and P.G.T. Healey (2006) “Clarifying spatial descriptions: Local and global effects on semantic co-ordination” in Proceedings of Brandial06, pp. 122–129
- Mills, G. (2007) Semantic co-ordination in dialogue: the role of direct interaction. PhD Thesis, Queen Mary University of London.
- Mills, G. and Healey, P.G.T. (2008) Semantic negotiation in dialogue: mechanisms of alignment. In Proceedings of the 8th SIGdial, Columbus, OH, US; June 2008.
- Mills, G and E Gregoromichelaki. in prep. Coordinating on joint projects. Based on talk given at the Coordination of Agents Workshop, Nov 2008, KCL.
- Pickering, M., Garrod, S. (2004) Toward a mechanistic psychology of dialogue. *Behavioral and Brain Sciences*
- Purver, M., Cann, R., Kempson, R. (2006) “Grammars as parsers: Meeting the dialogue challenge”. In: *Research on Language and Computation* 4(2-3), 289–326
- Purver, M, Howes C, Gregoromichelaki, E, Healey, P (2009). “Split Utterances in Dialogue: a Corpus Study” In: Proceedings of SigDial 2009