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A Grammar for Language and Co-verbal Gesture

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Meaning in everyday communication is conveyed by various signals including spoken utterances and spontaneous hand gestures. The literature has attested that gestures function in synchrony with speech to deliver an integrated message, or a “single thought” [5], [1], exhibit language-specific properties [2] and are subject to formal semantic modeling [3]. One of the challenges in modeling synchrony is to use the form of the verbal signal, the form of the gesture and their relative timing to produce an integrated meaning representation. We meet this challenge by exploiting well-established semantic composition rules for deriving meaning from the form of the multimodal action. So, while the existing grammars (HPSG, LFG, CCG) produce semantic representations for unimodal input, we argue that any formalisation of language should fit into the multimodal perspective of synchronising language and co-verbal gesture.

The temporal performance of the gesture, its dimension(s) and ambiguous form do not uniquely determine the synchronous linguistic phrase. This raises the distinction between synchrony and simultaneity, thereby allowing for a gesture to attach to more than one constituent without causing ungrammaticality or incoherence. Nevertheless, the choices of attachment are constrained. We consider (1) ill-formed despite the semantic relation between the container shape of the hands and the books (pitch accent is shown in caps).

(1) I GAVE you **the other books**

Along with “the other books” both hands in ASL-B shape move forward to the frontal centre, palms facing one another, half foot apart.

Here the gesture along with the prosodic phrase contributes contrastive effects in the hearer’s model and it should combine with a phrase containing the pitch-accented item.

An overall challenge is to constrain synchrony in a way that rules out ill-formedness, while producing underspecified logical forms supporting all plausible interpretations in the context-of-use.

We define well-formedness constraints in terms of prosody, syntactic constituency, headedness and timing. In the full paper, we will use a detailed study of a multimodal corpus [4] to motivate that the synchronous phrase to a gesture can be:

1. the temporally overlapping head provided it bears the pitch accent. Suppose the gesture in (1) spanned the whole utterance, this enables attaching the gesture to “gave”, making it depict “gave”.
2. a constituent larger than the head, provided the head and its immediate constituents form a ‘sense unit’ [6], and the prosodically prominent element overlaps gestural performance. This rule would attach a sentence-spanning gesture for (1) to the head upon partially or fully saturating it: “gave you”, “gave you the other books”, “I gave you the other books”.

The choice is still constrained: no rule enables “you the other books” or “I” to be synchronous: the former violates the sense unit condition and the latter the prosodic markedness.

We will further show that any formalism that interfaces syntax/semantics and prosody is well-suited for regimenting synchrony and its effects on multimodal meaning, regardless of whether the surface syntactic structure is isomorphic to prosodic structure (e.g., CCG) or not (e.g., HPSG, LFG).

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