We have a simple memory system (in at least one way) and our language is limited accordingly (in at least a couple of ways)

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Composition and recursion have been important topics in the modeling of cognition in general—though not always presented in precisely those terms. In the cognitive modeling of language, work has often been reductive—attempts are made to explain apparent syntactic properties in terms of general properties of cognition. This naturally leads researchers to focus on whether or not such reductions truly work (*e.g.*, Sprouse *et al.*, submitted; Phillips, in press). Our interest here, however, is purely in the architecturally supported computations. In one system (Anderson *et al.*, 2004), composition comes easily (perhaps too easily), from the basic modeling mechanism; phenomena like garden-paths follow pretty closely from the general architecture; and support is natural and immediate, or fundamentally lacking, for precisely those kinds of recursion that do and do not occur in language.

For us, the Anderson *et al.* system has two or three essential parts. Declarative memory (in the temporal lobe, references in Anderson *et al.*) holds the lexicon; it's accessed through a retrieval buffer (in the ventrolateral prefrontal cortex) by a production system (Newell, 1973) for the selection and execution (in different parts of the basal ganglia) of rules. The current production system, though quite general, appears (Anderson & Lebiere, 1998) to produce elements of the right grain size (perhaps even 'atomic components of thought'). One or more activated rules cause the retrieval and grouping of items from the lexicon or working memory (essentially implementing Merge). One pressing question concerns a child in the one-word stage, combining gestures with those words, on the verge of entering the two-word stage (Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). A model in the style of an Anderson *et al.* system would represent this as the state of being on the verge of formulating a new production rule for taking an already-composed concept of two already-named parts, and expressing it by the (two) words for those parts, in (a learned) order. We note, as an aside, that the learning of one such production, applied to head-complement combinations, supports head-directionality.

One higher-level cognitive behavior has unduly influenced modeling architectures—and linguistic theorizing, too, perhaps. Namely: the nesting of goals and subgoals (achieving goal A by first achieving (sub)goal B, and so on; A must be held on to until B is finished and released, Miller *et al.*, 1960). Seen as a (putatively) natural facet of human cognition, a simple (and computationally convenient) mechanism—a last-in, first-out stack of goals—has thus been found in systems such as Anderson & Lebiere, and Newell (1990). As has long been noted, however, a stack supports—contrary to fact—potentially deep center-embedded structures (Miller & Chomsky, 1963). Similarly, it supports general back-tracking mechanisms, potentially eliminating all garden-path effects. Altmann & Trafton (1999, 2002) show, however, that behavioral data on the comparatively high-level tasks are best modeled with general memory cueing and retrieval mechanisms; hence a stack is psychologically unsupported, and the current system of Anderson *et al.* does away with it. This leaves recursive composition of linguistic material as a near impossibility except where no stack-like patterns of storage are found (*e.g.* in arbitrarily deep left or right-branching); elsewhere, for comparatively low-level processes as found in (areas of) language processing, spectacular failure is not surprising. Lewis & Vasishth (2005) show how a stack-free system can be used to closely model language phenomena in things like center embeddings.

There is a long tradition of positing memory resource-limits as the cause of such failures (so to speak) of the language system (references in Lewis & Vasishth). The developments in cognitive modeling sketched above show that there may instead be deeper architectural reasons for these apparent performance issues—and hence, important restrictions on the kinds of mechanisms available for creating language.

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