



Metacognition in a CMC Workgroup Paper (Kralik *et al.*)

'**Broad cognition**' includes perception, reasoning, learning, and action, as well as other cognitive abilities, e.g. understanding natural language, imagination.

'**Broad metacognition**' includes combinations of broad cognition applied to broad cognition...

Inner speech is perhaps the single best example of 'broad metacognition': a perception of a silent speech action expressing a thought in natural language, which can refer to other thoughts, perceptions, or actions.

Inner speech may play an important, enabling role in human cognition. It indicates cognitive plausibility of a **natural language of thought**. Fernyhough's studies indicate cognitive plausibility of a '**generalized society of mind**' architecture, per (Doyle, 1983) rather than (Minsky, 1986).

Consciousness involves perceiving oneself and one's reasoning, i.e. a form of metacognition. An artificial cognitive system can have '**artificial consciousness**'.

Thoughts on Bands of Action (Jackson, 2018)

"days-months"

Social Band

Different reasons are given from Newell's for considering the Social Band to exist and be distinct from the Rational Band. Although Newell suggested ~10 minutes might be a minimal timescale for "significant actions" in the Social Band, reasons are given for minimal timescales of a few seconds. **The importance of the Social Band in helping to create the Cognitive and Rational Bands is discussed.** The impact of modern technology on the Social Band is described. Some **potential development directions for CMC** are suggested.

"mins.-hrs."

Rational Band

Iterations & combinations of cognitive band thought processes can happen over longer timescales corresponding to the rational band. (Newell only mentioned using knowledge to solve problems.)

0.1sec-10sec

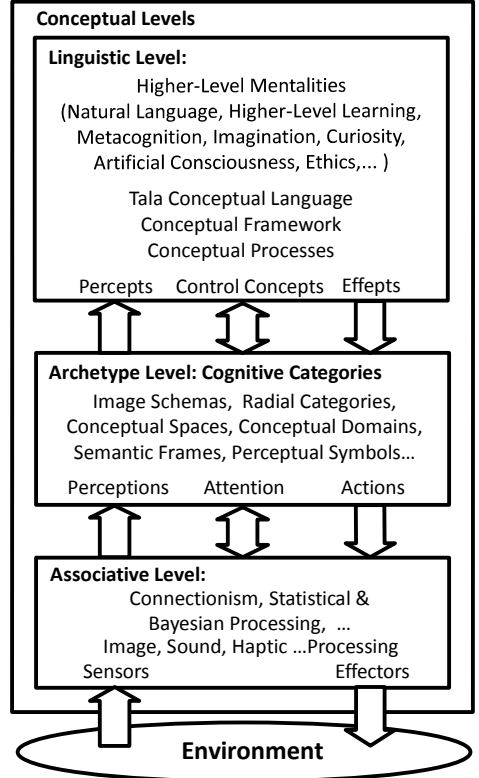
Cognitive Band

In addition to search & problem-solving, **other thought processes happen in the cognitive timescales:**

- Using and understanding natural language.
- Learning by creating explanations and predictions, using causal and purposive reasoning. Learning about new domains by developing analogies and metaphors with previously known domains.
- Imagining hypothetical situations. Spatial-temporal reasoning and visualization.
- **Metacognition**, analogical reasoning, causal and purposive reasoning. Thinking about the past, the present and potential futures.

"timeframe estimates", Newell (1990), p.122.

TalaMind Architecture Tala Agent (Jackson, 2014 *et seq.*)



Natural Language in the CMC (Jackson, 2018)

This paper advocates:

- **Developing a CMC using an internal language (called Tala) based on the unconstrained syntax of a natural language (English)**
- A cognitive cycle using pattern-matching of Tala expressions for information and procedures.
- Taking a principled approach toward supporting the unconstrained semantics of natural language.
- Using Tala as a symbolic language for representing information and procedures.
- Developing the TalaMind architecture for systems to achieve a human-level CMC and human-level AI.

In Tala, natural language expressions are symbolic data structures that represent natural language syntax and can refer to cognitive categories for semantics.

Arguments for **cognitive plausibility** of a '**natural language of thought**' are given, based on Jackendoff's argument for '**sentential concepts**', and based on the nature and existence of '**inner speech**'.

The TalaMind demonstration system is discussed.

Theoretical and strategic issues for the CMC are discussed.

This approach is advocated to achieve Newell's long-range goals for 'unified theories of cognition'.