Predictive brains and coordination dynamics

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Role of prediction in coordination dynamics

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"The key task performed by the brain…is that of guessing the next states of its own neural economy. Such guessing improves when you use a good model of the signal source. Good guesses thus increase the posterior probability of your model, and various forms of gradient descent learning can progressively improve your first guesses"
(Andy Clark, "Whatever next", ms)

Brains learn to perceive by **learning to predict sensory inputs.**

Successful perception occurs when a driving sensory signal gets **matched** by a complex flow of top-down predictions.

The match is established by multiple (and parallel) bouts of signal passing between populations of cells some sending **predictions downwards**.

Other populations send **residual errors** (signaling mismatches) **upwards.**

Action: The brain predicts some non-actual sensory (usually proprioceptive) states, and then **cancels out** the (now highly weighted) errors by **moving the body so as to cause the predicted states to occur.**

Actions make motor predictions come true. Our expectations about proprioceptive consequences of moving directly bring moving about.

Perception and action follow the same computational principles: reduce prediction error to a minimum.

Could coordination required for pre-linguistic common-ground also depend upon this computational principle?

Perceptual, motor and affective processes establish a ground-floor **pre-linguistic shared understanding** presupposed in linguistic communication.

Perception-behaviour expressway: synchronisation, mimicry, contagion, *etc*.

"…covert imitation functions as part of a *perceptual emulator*, using implicit knowledge of one's own body mechanics as a mental model to track another person's actions in real time." (Wilson & Knoblich 2005: 466)

Covert imitation is **predictive** - whether it is also **postdictive** is further question.

Hypothesis: emulators are generative models required for **coordination.**

Coordination is an aspect of **common ground**.

So emulation (= covert imitation) contributes to establishment of common ground *via* its role in securing coordination.

- **Shared Affective Motion Experience** in music perception:
  – "..simulation mechanisms implemented by the human MNS…allows a listener to reconstruct various elements of a piece of music in their own mind (bringing together auditory, motion and emotion information." (Overy & Molnar-Szakacs 2008, 493)

- **Modified proposal:** mirroring is basis for synchronisation and coordination that establishes common ground.

- Why is conversation so easy? (Garrod & Pickering 2004)

- Conversation is a joint activity in which interlocutors **align** their situational models.

- Use language production mechanisms as emulators during language comprehension.

- Emulations make possible alignment of situational models.

Is alignment of situational models the whole story in communication?

"…when two people talk, they spontaneously converge in terms of pausing and speaking duration, speaking rate, turn duration, response latency, vocal intensity and accent. Movements and postures likewise, appear to be spontaneously coordinated." (Shockley et al 2009: 306)

Interpersonal coordination of this kind is also necessary for smooth conversation.