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Week 10

Meltzoff & Decety: What imitation tells us about social cognition

The authors propose that imitation is the link that allows humans to develop a theory of mind of others. Imitation comes before theory of mind (both in development, and evolution) and is instrumental to its formation. Experimental evidence suggests that infants already have some ability to map between perception and production, and it is thought that these modalities share a common representation. Neurological evidence also indicates a connection between perception and production - similar brain areas are activated for perception and production of an action.

Meltzoff describes how infants proceed from simple imitation to a state where they seem to have an understanding of the imitation game - they know that they are in an imitation interaction, and perform actions to make sure that they are still being mirrored. They can also detect if another person is imitating them, instead of the other way around. Further evidence shows that the infants are modeling goals - they can repeat an action and accomplish the goal from only a failed example, where the goal was not accomplished. Imitation may provide the key for this, linking observed acts to your own. They describe a 3 step process, where first the infants must be able to map from other to self - then they must experience things in the world, so they learn appropriate relationships (such as mapping between facial expression and emotion) - finally they use these two things to make inferences about others.

I quite like the ideas presented here, as we have done much work on similar structures for providing these inference abilities to robots. The accumulating evidence for these processes in humans makes me feel that the most straightforward path to socially intelligent computers is through embodiment with similar capabilities to humans, so that the robots can use these mechanisms to relate self to other for greater understanding of human interactors.

Langton: Do the eyes have it? Cues to the direction of social attention

The authors set off to show that eye gaze has a special significance; we may have special neurological mechanisms for observing other's eye gaze allowing us to process it easily and allowing it to unconsciously influence our own gaze direction. They describe how a very simple process can determine eye direction based on some low level visual processes. The description of how to get eye direction this way is compelling, however you must first determine where the eye is, which seems like it would require more complicated processing. They also present evidence for unconscious gaze following, in an experiment where subjects (to their detriment, in the experiment) can't help but follow the gaze of a picture of a face.

They present a theory for determining where someone's attention is that uses multiple cues - the eyes are the most powerful, but in their absence the head or body direction can be used to attempt to guess direction of attention. There is also some evidence that though it is not helpful, head direction is also incorporated even when eyes are visible, causing some slight errors. Other evidence suggests that infants do not use the eyes at all as a directional cue. This might explain the inaccuracies of the system - it is designed to work both for infants that cannot yet determine eye gaze and for adults that can, optimizing for a solution that works well for both but perfectly for neither.

This paper hints that the eye is an especially easy shape to track for our visual system, though it did not seem to be suggesting that the eye evolved especially for that purpose. While that is possible, it seems more likely that our visual receptors evolved to make it easy, or that the importance of eye gaze developed because we could easily determine eye direction.

Gallese: Mirror neurons and the simulation theory of mind-reading

This paper describes findings about mirror neurons, and argues that they support simulation theory models of Theory of Mind over theory theory models. The authors provide neurological evidence of a type of neuron in the F5 cortex area which fires both when the subject performs an action, as well as when the subject observes that action being performed. The evidence is mainly from monkeys, but the neurons are reported to be in humans also. The authors propose that these neurons underlie human's "mind reading" ability. They also contrast simulation theory with theory theory, and argue how mirror neurons are evidence of a simulation theoretic method. They mention a lesion study where patients without an inhibitory mechanism compulsively imitated experimenters, arguing that we normally understand movements of others as motor plans, but are able to inhibit their production.

This lesion study is also good evidence of Barsalou's simulator's theory - when we see a motor action it partially activates our own production action, which in fact is our representation of the action.