How our brains build social worlds

02 December 2009 by Andreas Roepstorff , Chris Frith and Uta Frith

YOU know how it works. A student volunteer sits alone in a soundproof booth, watching a computer screen and waiting for moving dots to appear. When they do, he or she has to decide whether there is a walking man hidden somewhere in those dots. If there is, and he is walking left, the volunteer has to press the left button. It's a tricky task, and most of the time people end up guessing.

In our view, this kind of traditional experiment has a serious limitation: it does not take into account the influence of social interaction. On the surface, of course, no social communication is involved, as the volunteer is alone in a room. But dig deeper, and you'll find plenty. For one thing, the man hidden in the dots is a social stimulus, although not one that can interact. Such experiments involve social communication at another level, too. Any participant brings his or her baggage about what psychologists are like and how volunteers should behave.

The problem is that these hidden social interactions remain out of focus in the experiment. Our aim at the Interacting Minds project at the Danish Neuroscience Centre in Aarhus is to develop a new kind of experiment that is focused on such interactions.

In the past decade, the neuroscience of social behaviour has blossomed. A major catalyst for this has been the discovery of what seems to be a physiological mechanism for social interaction, located in the brain's "mirror neurons". These have been seen to fire not only as a monkey, say, grabs a peanut, but also when the monkey sees an experimenter do the same thing. Imaging experiments in humans have similarly revealed parts of our brains becoming active when we see someone moving, or even when watching a walker hidden among moving dots. It seems we are not just observers of the social scene but that we automatically share the experiences and emotions of the people we are observing.

This is only half the story, though, as interaction between people extends far beyond this. When I see you in pain, I feel your pain and my face automatically expresses this pain. What's more, you can see by my expression that I share your pain, and you are comforted by the knowledge someone else shares your pain. You are responding to my response to you.

Such interactions are a feature of many aspects of everyday life. They come to the fore when people play music, so in one of our experiments we got two people to tap a simple beat together. You might expect a leader and a follower to emerge, with the leader trying to maintain the beat, while the follower synchronises with the leader. Our twist was to also study what happened when each person could only hear the other, but not him or herself. No leader emerged: both players became followers, continually and mutually adjusting their taps to each other.

How can such behaviour be explained in terms of neuroscience? We think that two people performing together in this way are best described as a single, complex system rather than as two systems interacting. We also believe the same kinds of description should be applied generally to the brain activity that occurs when two people interact, because their brains also become a single complex system.

During any kind of social interaction people unconsciously imitate each other, or else show the appropriate complementary action and reaction. When this happens, the parts of the brain that unconsciously respond to the actions of others create a form of resonance. We are not usually aware of this, but when it occurs we feel "on the same wavelength" as the person with whom we are interacting.

This feeling of similarity is an essential aspect of communication, and it is generally easier to communicate with someone who we feel is similar to ourselves because of the knowledge we share. There is, however, another important part of communication, and that is to learn new things. So, as well as bearing in mind our similarities, we must also keep track of our differences and, in particular, the things that we know and that other people don't know. Think of the appeal of gossip.

There is nothing specifically social about building models of the world. The brain does this when we are alone and unobserved, as it learns about the world and creates perceptions and beliefs. On the basis of those beliefs, our brain predicts what should happen next and decides if the sensory signals it then receives provide evidence for or against that belief. When it finds errors in its predictions, the brain acts as a hypothesis engine, continually updating our beliefs about the world. Think of the unexpected sensations when you lift a coffee pot you thought was full and it turns out to be empty.

But what makes human social interactions so fruitful in daily life - and as a subject of study - is our ability to compare our model of the world with other people's. We know something about how the brain models the world, but we need to know a great deal more about how our brains model other people's models of the world. People continuously put this kind of modelling to use when doing things with others: when we talk, teach, listen or learn. Good teachers know that and tailor their teaching accordingly. So do stage magicians as they play with our expectations and divert attention from where the trick is really happening.
We need to know how the brain models other people's models of the world

This raises the interesting question of how our brains deal with deception. Somehow, a balance has to be struck: it would be too costly to question the motive behind every interaction, but taking everything at face value makes us vulnerable. Neuroscientists have become very interested in the differences in brain activity between interacting with a person considered trustworthy and one perceived as dangerous and deceptive.

One key difference may be a shift in the balance between unconscious mirroring of another person's actions and expressions and conscious attempts to grasp the other's motives. This may lead to a decoupling from the other, a kind of separation within the interaction, as activity diminishes in areas that mirror experiences, while higher-order, cognitive frontal functions kick in.

A major aim of the Interacting Minds project is to understand the ability to compare, exchange and jointly create models of the world. Our group has forged strong collaborations with humanities departments at the University of Aarhus because we need their expertise on the shared worlds of human culture. It is these models that create the common knowledge that makes communication possible, including between experimenter and volunteer in experiments.

These shared models are often more robust and longer-lasting than the individual models. We experience them through symbols and words, which work precisely because there is general agreement about their meaning. This is how the paper and base metal we call money, for example, lets us communicate a value that can be applied to any commodity. In the right context, any object can become imbued with meaning. Just think of the collection of graphics now universally understood to indicate good humour (;-)!

The internet has dramatically increased both the possibilities for interactions and the size of the interacting groups. Undoubtedly, new shared models will emerge. But there are also greater possibilities for false models, in the shape of deception, propaganda, or genuinely held but dangerously wrong-headed ideas - creationism, the denial of global warming, take your pick. The possibility that neuroscience can help us understand the spread through society of true or false models of the world surely gives our work particular urgency.
Profile

Andreas Roepstorff leads the Interacting Minds project at the Danish Neuroscience Centre, Aarhus. Chris Frith and Uta Frith, both based at University College London and the DNC, have been awarded the European Latsis prize for their contribution to understanding the human mind and brain