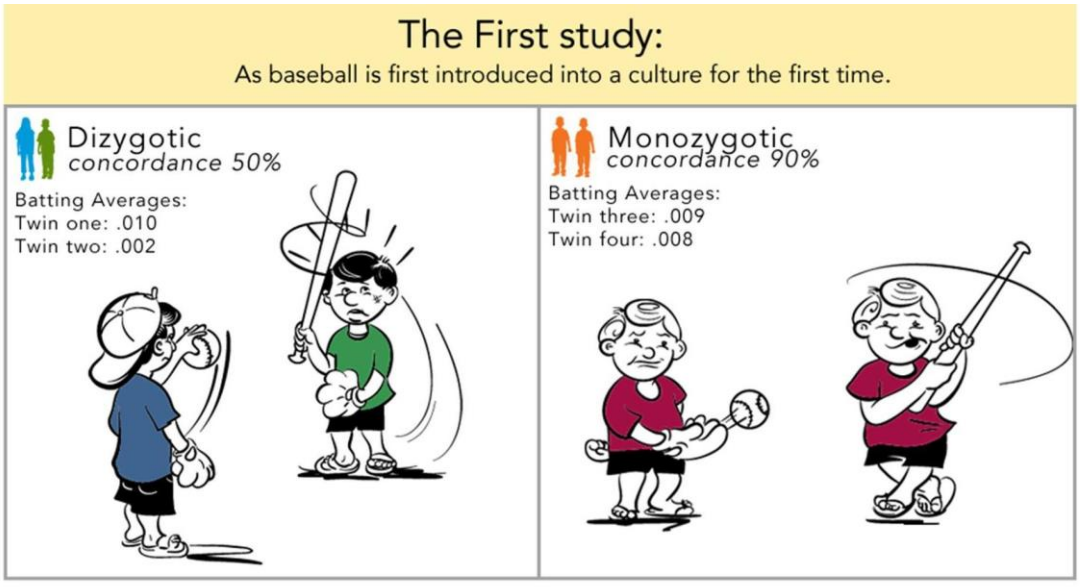
(EXCERPT FROM *PIED PIPERS OF AUTISM)*

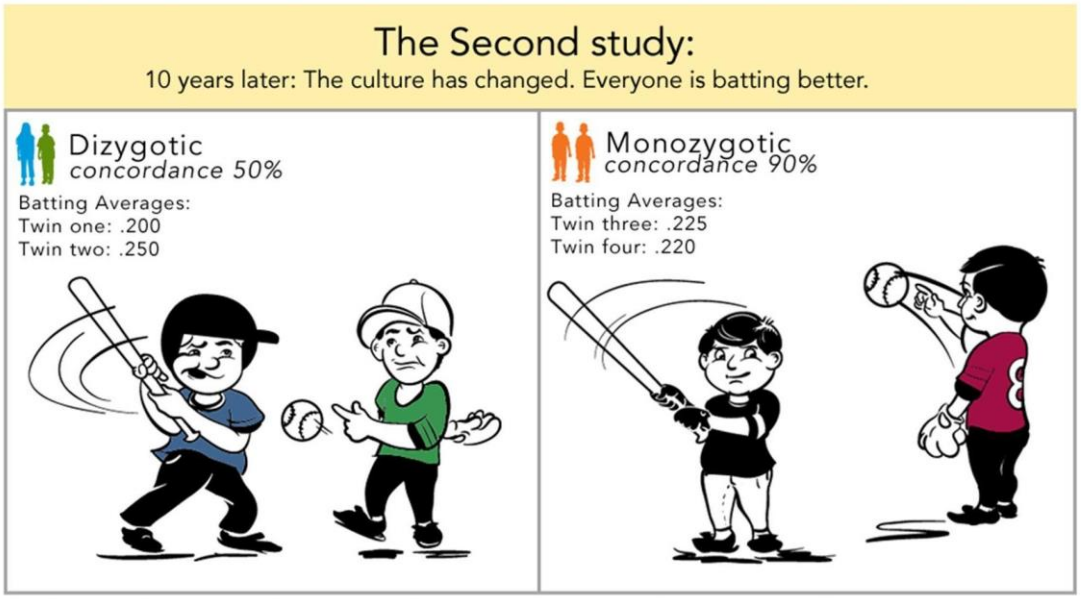
Learning - Imitation and the Mirror Neuron System

As the infant meets the world during the first year of life need-states arise that can only be satisfied by learning new capabilities. Once he or she can make sense of the visual world about them they can start to learn by observation and imitation how to do these things.

There is a special system in the brain called the *mirror neuron system* that is very involved with observation and imitation. It involves as special area of the brain. It reacts to observation of the actions of other people. For instance there might be a neuron that responds to the observation of someone catching a ball. This neuron fires when this action is observed regardless of who is catching the ball or whether the catch takes place near or far. The observation of anyone catching a ball at any time will cause that neuron to respond.



Both DZ and MZ twins can barely hit the ball. Study 1 concludes: The big difference in Concordance between MZ and DZ twins shows the trait is 90% Genetic.



Both DZ and MZ twins play pretty well now. Study 2 concludes: The big difference in Concordance between MZ and DZ twins shows the trait is 90% Genetic, again.

That is amazing feat of brain organization. But then the mirror part comes in. Without actually moving, the neurons that would be needed for us to imitate the catch fire off in turn, mirroring the catch in our own mind. This represents a mental imitation of the observed action. As these observations are repeated, some learning will take place.

Just as there are mirror neurons that mirror observed motions, there are mirror neurons that mirror sensations and emotions. When we see someone being touched, we, in a sense, feel that touch as well. Likewise, when we see someone happy our mirror neurons for that emotion will fire off. This is core of empathy.

We do not have mirror neurons for objects. No matter how many smiles we paint on a ball we don't as adult feel that the ball is really happy. For a baby this can be harder distinction. It is this confusion between objects and living beings that causes ASD. After all, we have two-way communication only with living creatures and only one way communication with objects. As babies are exposed *objects that mimic living beings* more and more, ASD will become more common.

For a time it was thought that a failure in the development of this mirror neuron system was the core defect in ASD. Children with ASD do have problems with imitation of people. With further research it was found that the mirror neuron system operates normally in children with ASD. They just do not seem to have the interest to observe and imitate other people.

The ability to imitate other people is an advanced social skill. It requires one of advanced social interactive skills that are acquired by children long after the first year of life. The initial failure, during the first year of life in children with ASD, to develop simple social communication skills precludes its subsequent development.

This capability to learn via observation and imitation can be astounding. There are people who can watch a complicated dance step and then turn around and perform it instantaneously. This kind of learning provides the **how** in learning. We learn **how** to throw a ball, speak a language, and so forth by observation and imitation of other people in our social networks who already have these skills.

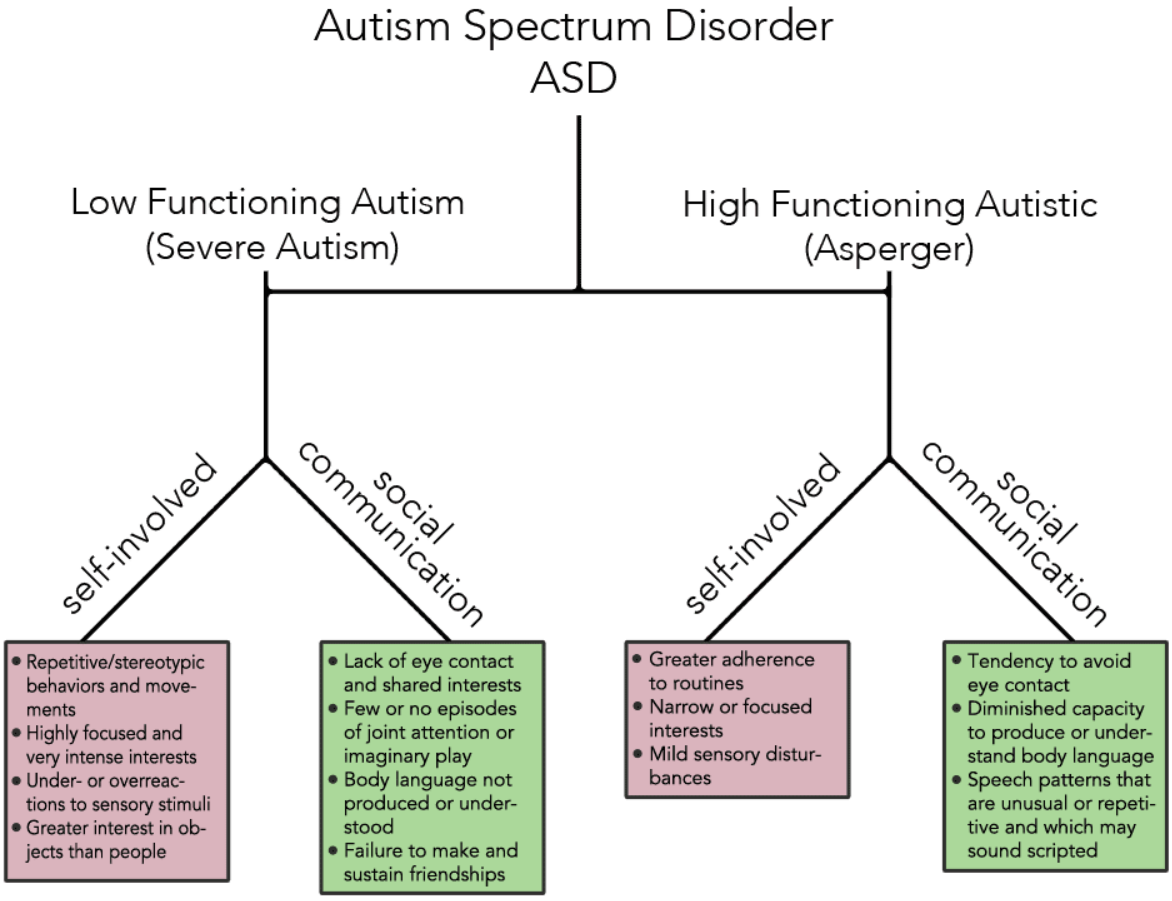
The learning process for these skills involves joint attention as well. We observe how other people in our social network respond to our motions and behaviors as we acquire these skills. In joint attention, there are always three elements: the subject, the trusted observer, and the event (which in this case is our execution of a given behavior). We learn by interpreting the reaction of the observer, who acts like a coach for us. Without joint attention, this form of learning is impaired to varying degrees in people with ASD.

Learning – Attention

Attention is the key to learning. Without attention, nothing is learned. Attention is really a way of saying that the brain is in a state ready to learn and react to the world around us. While awake, and I hope my readers are still awake, we are surrounded by a world of sensation.

As I am writing this, I can feel the breeze coming through the window, hear the computer's little fan, and feel the cushion in my chair. I am not paying attention to these sensations very much. I have a need-based state that I am focused on. My need-based state is to share my thoughts with you by writing this book. As I write these words and express my thoughts to you, I get a little closer to my goal and it feels good. The elements of attention are alertness, a need-based state, and a goal that hopefully can be realized.

There is another aspect of attention; suppose I am sitting in my room by myself and I hear a creaking noise in the hallway outside my room. I will quickly forget my book and listen attentively to the noise. Could it be the footsteps of an unwelcome stranger? Fear will direct attention very quickly. Hope and fear are basic emotions then serve to focus attention and learning. The normal child learns what is fearful and what is hopeful by observing the behavior of other people in their social networks. In ASD, the triggers of hope and fear are often idiosyncratic, distinct from normal behavior for their social network.



Learning - The Scaffolding

Learning is acquired one step at time. Many times there is a sequence of skills or abilities that must be acquired in a certain order to develop a certain capability. Later in Chapter Six, I will discuss language acquisition in some detail, which provides a wonderful example of this principle.

Most capabilities can be broken down in to sub-capabilities. Only when all the sub-capabilities are functional can the capability be learned. I cannot learn to write until I can hold a pencil, make a straight line, make a loop, and read. Education is very concerned with the sequence of lessons that are needed to learn a certain bit of knowledge. For instance, addition cannot be learned until integers are understood. If each step is important for learning the next step, then failure to learn the initial step will cause a cascade of failures as each step requires the successful completion or acquisition of the prior step. Again, this is a huge issue for teachers handling a classroom of students.

Learning - The Role of Social Networks

The social network in which we live plays a very important role in selecting which capabilities we will have the motivation and interest to develop. For instance, some of us have the innate ability to memorize entire sagas word for word. In preliterate societies this capability was highly valued. These stories which bound the culture together were passed on from generation to generation by people who committed them to memory. We are not talking about simple children stories. Some of them were more like soap operas with many characters and a very complicated plot. They were so long that had to be continued night after night.

Imagine a world without books, radio, writing, or any way to record speech: almost all communication was two-way and face-to-face. My guess is that ASD was very rare at that time. Humankind lived like that up until a few thousand years ago. How thrilling it must have been in those times to hear the old and treasured stories of your social network! Today in India there are still a few men who live and perform this oral tradition. Sadly, their sons do not have much interest in carrying on this tradition. It will soon be an amazing ability that mankind will lose, not because humans have lost the inherent ability to perform this task, but because it is no longer valued in our social networks; it is not needed and will be soon forgotten.