Cognitive Empathy: Its Development, Genetic Influence, and Mechanisms of Control

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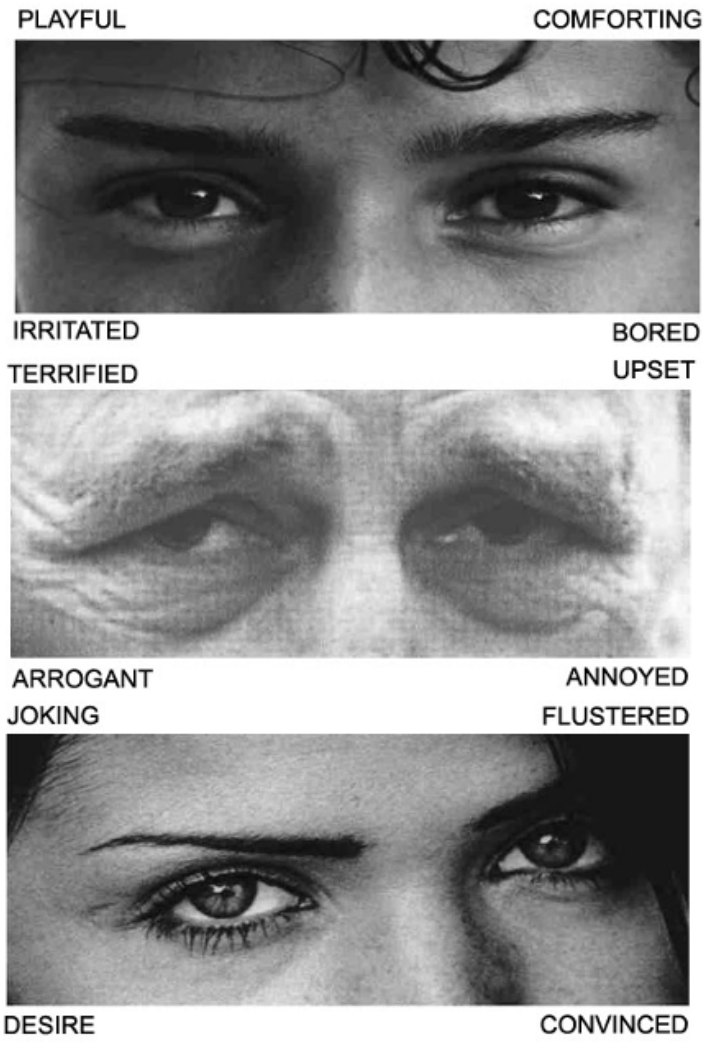
Empathy plays a critical role in morality and social cognition. The term “empathy” first emerged in 1909 as a Greek-rooted equivalent of the German word Einfühlung, meaning in-feeling. The etymology of this term gives it a new dimension because of how it allows us to understand empathy as the ability to emotionally connect with not only other human beings, but with literature, art, animals, characters, symbols, and anything else in our surrounding world.

Empathy has also been a popular research focus in neuroscience and psychology. Recently, studies have brought about new insights on the development of cognitive empathy, sex-specificity, and voluntary control of empathy in humans. Further scientific discoveries in the building blocks of empathy can potentially bring us closer to a more empathic society and compassionate world.

The development of cognitive empathy

Current research strongly associates the development of empathy and prosocial behavior with parenting style and technique. Gentle parenting, for example, has been found to increase the likelihood that a child will have a better understanding of empathy through patience and sympathy as opposed to fear and punishment. From a very early age, children already experience moral dilemmas within their families, and by the age of two, they already have an established understanding of right versus wrong, social rules, and fairness. There are significant arguments in favor of environmental influence being the largest factor in the development of empathy and prosocial behavior. And while many studies are consistent with this outcome in developmental literature, there is also sufficient research to suggest a degree of heritability as well.

To address the challenge of recognizing if a behavior has been inherited or learned from a parent, researchers assessed empathetic behaviors in both biological mothers with antisocial behavior and adoptive mothers who practice low positive parenting techniques. In a 2016 study of 561 families, the children of biological mothers who demonstrated antisocial behavior and of adoptive mothers who rarely practiced positive reinforcement were more likely to develop similar callous-unemotional behaviors. In both cases, children were observed to develop unemotional and apathetic behaviors around the age of two years, suggesting that there are heritable and non-heritable pathways to empathetic and apathetic behaviors. It is also evident that parenting is significant in the development of behavior and that empathetic behaviors develop through both genes and environment.



In what is considered the first large-scale investigation of the genetic role of empathy, researchers studied data from 88,056 individuals who were customers of 23andMe, a DNA ancestry test kit, and who all completed an online version of the “Reading the Mind in the Eyes” test (Eyes Test). This tests one’s ability to recognize the mental state of another in a series of 36 black and white photos of just a person’s eyes and is widely used to study cognitive empathy. The participants, 44,574 females and 43,482 males, were genotyped.

To ensure that participants were at most distantly related, only those who were of primarily European ancestry were selected for analysis. Further, 1497 participants of Caucasian ancestry were selected from the Brisbane Longitudinal Twin Study (BLTS) to take a version of the Eyes Test with only 14 questions for a 2015 study on the genetic and environmental influences on behaviors in twins.

From three sex-based genome-wise association study meta-analyses (GWAMAs), used in genetics research to associate genetic variations with particular diseases or traits, researchers were able to use a statistical technique to quantitatively separate the influences of genetics and other confounding factors. They discovered that heritability was about 28% in the 749 twin individuals, which is parallel to previous literature on cognition in twins, and in the unrelated participants who used 23andMe, approximately 5% of the trait was heritable.

Understanding the heritability and the differences in brain responses between males and females is significant. Finding that empathy is even somewhat due to genetics can be helpful for us to further connect with and support those who may struggle to conceive the feelings and emotions of others.

Sex-specific genetic makeup of empathy

The results from the meta-analyses also revealed that the scores on the Eyes Test were strongly correlated with sex. Females scored significantly higher than males, and there was an observed genetic locus that was associated with scores on the Eyes Test in females. These findings align with those of previous research and suggests a sex-specific genetic foundation of empathic traits.

A 2019 study by researchers from UCLA further investigated sex differences in empathy by utilizing brain imaging. 70 participants were observed during a functional MRI (fMRI) scan while viewing two different video clips: a human hand being poked with a cotton swab and a hand being poked with a syringe. Their objective was to observe the brain's initial responses to the sight of another's pain.

fMRI does not necessarily measure brain activity, but instead the changes in blood flow. An increase in neural activity causes a subsequent increase in cerebral blood flow to that area of the brain. Greater blood flow means an increased ratio of oxygenated blood relative to deoxygenated blood, and the changes in this ratio is detected by fMRI by measuring the blood oxygen level dependent (BOLD) response. When one observes another's pain, a person's natural response is to mimic that pain. The specific area of the brain associated with others' pain was observed to be more active in females than males, demonstrating that females may be able to "feel" the pain of others more so than males and thus are more likely to show empathetic traits.

Further research on the indication that a specific part of the brain responds differently to stimuli in males than in females could potentially improve the targets and dosages of treatments that specifically affect those areas of the brain. These findings are just the beginning of the road towards personalized medicine.

Empathy may be controlled voluntarily

In January 2020, researchers from the Netherlands Institute for Neuroscience published a paper on how humans can voluntarily adjust how and when they attribute emotions to others. Twenty-three male participants were observed in an MRI and were asked to rate the emotions of a protagonist experiencing a rollercoaster of emotions in two Hollywood movie clips. This was done in an MRI during three different sessions: "Empathetic, Detached and Own" Sessions.

In the "Empathetic" Session, individuals were specifically asked to empathize with the character through compassion and warmth. They were given a survey with a list of ratings to assess the emotional response of the character. During the "Detached" Session, the participants were told to be as removed from the character as possible. And in the "Own" Session, each individual was asked to evaluate and rate their own emotional responses to the clip.

They found that participants had consistent ratings of emotions in both the "Empathetic" and "Detached" Sessions, which suggests that the participants were similarly attentive during both sessions. When they were asked to empathize, participants rated the character's emotions slightly stronger than during the "Detached" Session; the character's positive emotions were considered more positive, and the negative emotions were considered more negative. Brain activity during the Empathetic session in limbic and somatomotor regions showed greater synchronization than during the Detached session. This suggests that the participants are able to understand and judge the emotions of others, but they can also regulate the degree to which they allow themselves to be affected.

When participants were encouraged to detach from the protagonist, there was an increase in the synchronization of the temporoparietal junction (TPJ), precuneus, and vmPFC. When synchronized, these parts of the brain all work together in cognitive processes such as decision-making and mentalizing, as well as in mechanisms of memory, reaction, and perception. This synchrony is extensively researched in social cognition; there have been multiple studies on autism spectrum disorders (ASD) that have suggested a lack of brain synchronization as an indication of abnormal brain activity. The overall results of the study show that the participants were able to choose whether to focus on the social and empathy aspects of emotion or on different forms of intersubjective sensitivity.

A greater understanding of the mechanisms of empathic traits and behaviors can help in fields like psychotherapy, which depends on helping people relate to other individuals and the society. Further, the neuronal and psychological

foundation of empathy is extremely complex, and thus greater awareness and knowledge through research can help us, as a society, understand and be more accepting of those with psychiatric disorders, such as psychopathy, narcissism, and autism, that are associated with impairments in social cognition. And empathy is perhaps the most critical aspect of the infrastructure of social cognition.

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