# Beyond the ‘Broken Mirror’: How New Brain Research is Improving Autism Interventions


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Autism affects the developing brains of children as young as two years old and may be characterized by a wide range of social, behavioral, and communication traits. The mirror neuron system (MNS) is a brain pathway that plays a vital role in learning how to imitate behaviors and understand the actions of others.

This article examines recent research that the MNS is altered rather than broken, and explores additional brain pathways involved in autism.

## Mirror Neurons and the “Broken Mirror” Hypothesis

These brain cells are primarily located in the frontal and parietal regions of the brain and are involved in planning and understanding movement. These specialized cells are active when a person performs an action or observes someone performing the same action.

The 'broken mirror' hypothesis suggests that dysfunction of mirror-neuron brain pathways hinders a person with autism's ability to perform or observe actions. When a person observes an action being performed, this hypothesis proposes that the same movement pathways in the nervous system are automatically activated.

This hypothesis does not conclusively link action observation difficulties to social and emotional challenges in autism spectrum disorder.

This literature review by Chan and Han (2020) examined the brain imaging studies (fMRI) of individuals with autism and neurotypical individuals. It demonstrated that MNS differences occurred only when observing hand gestures within an emotional context, such as a friend or loved one saying hello. Building on these findings, researchers developed alternative models showing the MNS is altered, not globally dysfunctional.

## The Social Top-Down Response Modulation (STORM) Model and the Emulation, Planning, and Mimicry (EP-M) Model

Researchers have begun investigating the social top-down response modulation (STORM) model and the emulation, planning, and mimicry (EP-M) models, two alternative brain pathway models formulated to explain the social and behavioral challenges associated with autism.

This model suggests that higher-level brain areas responsible for reasoning guide how we interpret observed actions.

The STORM model proposes that if communication between the decision-making brain cells (i.e., frontal brain regions) and those involved in planning and understanding movement (i.e., mirror neurons) is impaired, individuals struggle to recognize the social relevance of observed actions because they cannot utilize prior knowledge to interpret sensory information.

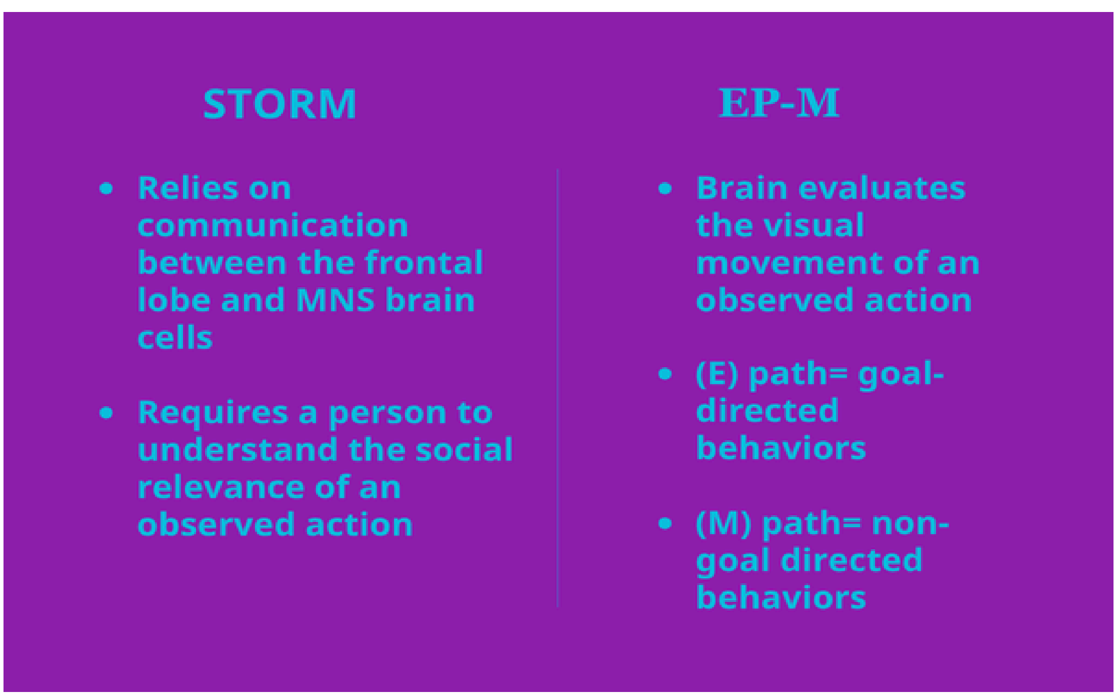
For example, when a parent asks her child to hug a family friend at a party, this communication gap may be evident, since the child may be accustomed only to hugging his mom and dad in his quiet home environment.

A complementary model, the EP-M, focuses on how the brain processes different types of observed actions.

The visual movement features of an observed action in the EP-M model are processed by the temporal lobes (i.e., brain regions above the ears). The emulation (E) pathway is used when an observed action is goal-directed. For example, when reaching for a cup. Whereas the mimicry (M) pathway is used when observing actions that are not goal-directed, such as waving hello.

The mimicry brain pathway is essential as it creates a direct connection between the visual elements of observed actions and their movement representations.

The STORM and EP-M models interact when disruptions in executive control may alter the EP-M mimicry pathway.



## Enhancing the Social Skills of Individuals with Autism: Real-World Applications of the STORM and EP-M Models

Research supports both models (Yates and Hobson, 2020). Future research should investigate the nature of top-down control from the frontal lobe of the brain in individuals with autism. This brain area processes the context of a goal-related task.

Since both models emphasize how individuals interpret social context and distinguish their own actions from others, self-other control emerges as a critical skill to develop.

The process of self-other control is central to the top-down model and requires further investigation. During this process, a person regulates their emotions and behaviors in comparison to others during social interactions.

Future interventions designed to improve social skills in individuals with autism should focus on training self-other control, as it has been found to improve social cognitive abilities such as empathy, imitation, and perspective taking (i.e., the ability to understand another person’s thoughts, feelings, and viewpoints), which all enhance one’s ability to interact in social situations.

This research focuses on self-other control, which offers more constructive support than previous studies that only examined simple imitation tasks.

## Summary

These models shift the conversation from deficit to potential by focusing on how individuals regulate their emotions and behaviors during social interactions and plan goal-directed actions.

Researchers and clinicians can design interventions that develop real-world skills, such as empathy, imitation, and perspective-taking. They can create these interventions through programs that enable individuals with autism to interact with both neurotypical individuals and their peers, thereby strengthening independence, confidence, and meaningful social engagement.

In short, exploring these brain pathways doesn't just advance science; it provides a roadmap for helping individuals with autism thrive in ways that respect their unique neurological profiles and empower them to connect more fully with the world around them.

## Further Reading

Autism statistics and facts | Autism Speaks
Top-Down Processing and Perception

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