



## Autism and the Brain

Insights for parents, teachers, and educators from research by [Dr. Matthew Belmonte](#), assistant professor and neuroscientist in the Department of Human Development at Cornell University.

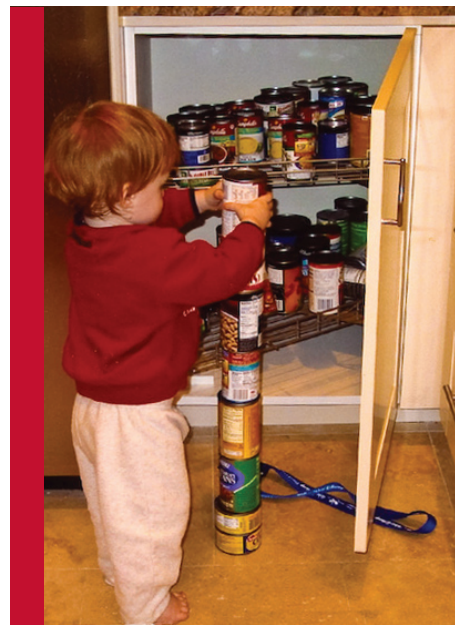
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In his research on autism, Matthew Belmonte has shown that, from a developmental perspective, both autistic and non-autistic children share many traits and developmental periods. Both sets of children attempt to make sense of their worlds and their surroundings. However, according to Belmonte, at some point during the normative developmental trajectory, autistic children begin to display different social, communicative, and behavioral aspects of development. When this occurs, these children adapt their environmental responses to their social, communicative, and behavioral reality. In so doing, they develop ways of existing within a developmental world that is different in many ways from non-autistic children but similar in a fundamental way—responding in an appropriate manner that is adaptive to the environments that they perceive.

### What Does the Research Tell Us About Autism?

To understand autistic children's adaptive response to environmental stimuli, Belmonte has conducted experiments that examine 1) brain region activation of autistic individuals and non-autistic individuals; and 2) how the brain responds to rapidly shifting tasks.

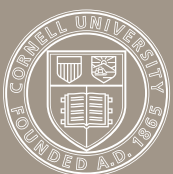
In the first experiment, autistic and non-autistic participants were each presented with tasks and then observed to determine the ease and skill with which information was transferred between brain regions. Individuals with autism activated one part of the brain—specifically, the region responsible for visual processing—and showed weak transfer of



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activity between brain regions. Conversely, non-autistic participants used several brain regions, with activity transferring between regions. In this experiment, the brains of autistic participants did not exhibit the same “communicative” ability as the brains of non-autistic subjects. This disruption in the extent to which separate brain regions “talk to each other” is thought to reflect autism.

In a separate study of 10- to 15-year-olds, Belmonte asked autistic children to look at two tasks and to suppress any outside distractions while viewing the tasks. The autistic children became very aroused when presented with tasks that required shifting attention. Unable to shift their attention rapidly, they “turned on” all parts of their brains. Belmonte explains that such children appear to have too



many neurons in the brain, which is responsible for an abnormal ratio of excitation to inhibition within brain regions. Belmonte theorizes that this is a result of appropriate developmental connections failing to form since normal development requires proper excitation/inhibition responses. He offers an analogy of stereo equipment to explain these findings: autistic individuals cannot change their equalizer settings rapidly; instead, they turn up their master volume control.

In the study discussed above, about eight to nine seconds after the experiment was over, the autistic children were able to turn down the activity in their brains. Belmonte describes this phenomenon as similar to arriving at a train station after the train has just left or joining a conversation at a cocktail party 10 seconds too late to pick up on a joke that was just told. This is precisely what is observed in the social interactions of those with autism—an offbeat timing in picking up social cues and attending to conversation.

### What Does the Research Tell Us About the Diagnosis and Treatment of Autism?

According to research, one of the earliest behavioral markers of autism is a “sticky” style of attention. Children demonstrating a “sticky” attention style do not become disengaged as quickly as non-autistic children, preferring instead to become narrowly focused on one particular object as opposed to many different objects or toys.

Autism is generally recognized and diagnosed by age five. In most cases, a child does not receive clinical attention until after symptoms develop. A provisional diagnosis may identify the disorder earlier, between two and three years of age, and sometimes even as early as 18 months of age. What typically occurs is that children begin showing signs of pronounced and repeated difficulties in social skills and language development, prompting the notice of parents who then seek medical and clinical expertise. In many cases, a child does not develop the social and communicative skills according to a developmentally appropriate timeline. (For more information on typical development, see the Talaris Research Institute timeline: <http://www.talaris.org/timeline.htm>.) Children in this category are diagnosed with non-regressive autism. In other cases, quite tragically, a child may begin to develop or already possess these skills and then suddenly lose them. Children in this category are diagnosed with regressive autism.

Belmonte explains that very little is known about the differences between non-regressive and regressive forms of autism, although brain growth may provide a clue.

Normally developing brains experience tremendous growth between birth and age two. But approximately one-third of children with autism are macrocephalic, that is, they have an exceptionally large head and brain resulting from an excess growth of brain tissue. This excess of brain tissue is believed to alter neural networks. Autistic children without abnormally large heads may have altered synaptic channels. Both environment and genetics seem to be implicated in autism. New techniques for studying biology and genetics have spurred research in this area, offering hope that these different forms of autism will be better understood.

Treatment options for autism include cognitive behavioral therapies and psychoactive medications such as risperidone (Risperdal). These treatments only address autism symptoms, not the underlying disorder. Cognitive behavioral therapies are behavioral treatments used to reduce anxiety and to teach autistic individuals explicit way to recognize emotional facial expressions and appropriate ways to respond to these expressions. Medication is also used to treat symptoms of autism including irregular sleep, repetitive behaviors, and hyperactivity.

Ongoing autism research is beginning to discover genes related to disruptions in the connections between neurons in autistic individuals. According to Belmonte, researchers do not expect to find one autism gene but rather several genes that disturb how neurons communicate. If too many of these genes exist in an individual, the person may be diagnosed with autism. In some cases a person with a few of these genes may develop autism, although more often, it is a combination of genes that is responsible for developing the disorder. Belmonte points out that at the same time as researchers work to understand the functions of these genes, they can begin searching for the biological pathways by which they influence development. This then opens the possibility for the development of autism drugs and other types of interventions that will address the underlying disorder.

### Future Directions for Autism Research

Belmonte continues to explore how autism develops—examining autism’s developmental roots as opposed to the endpoint. In other words, he is most interested in learning what goes astray along the normative developmental pathway for autistic children. Specifically, he is interested in learning about how simple cognitive capacities develop in order to understand the more complex cognitive capacities that build on the simpler ones. Discovering these answers may lead to further studies that determine when cognitive

abnormalities develop and what underlies the abnormalities in autism, including abnormal attention style, differences in integrating sensory-perceptual experiences, and differences in shifting and integrating attention.

Based on his research findings, Belmonte reasons that autistic behaviors may well be a developmentally adaptive response given differences in brain structure and function. Parents of children with autism and teachers who work with autistic children will likely find this to be a constructive reframing from the deficit-oriented model currently used to portray autistic behaviors.

### Tips for Caregivers and Educators

1. Consult a physician should you suspect that your child meets any of the following early predictors of autism:
  - Always recoils from touch or holding
  - Extreme focus on repetitive sensations (motions such as ceiling fans or tops, textures such as corduroy, sounds such as monotonous humming)
  - No sharing or imitation of facial or vocal expressions by nine months
  - No babbling by 12 months
  - No gesturing (pointing, waving goodbye, etc.) by twelve months
  - No single words by 16 months
  - No two-word spontaneous phrases by 24 months
  - Any loss of any language or social skills, at any age
2. Recognize that autistic children prefer to deal with concrete objects and facts.
3. Understand that autistic children may be unable to shift focus rapidly, or to attend to more than one situation requiring their attention and focus, or to process more than one sense (e.g. vision and hearing) at the same time.
4. Know that autistic children use adaptive strategies such as spinning to reduce stress and control their environments. Allow them to engage in these activities in safe and appropriate settings.
5. Appreciate that autistic children may perform better in individual as opposed to team sports. Although autistic children want to be social, team play with non-autistic children often requires an amount of rapid shifting and integration that is overstimulating for the autistic child. Timing and precision of body movements often are problems for children with autism.

### Further Resources

Matthew Belmonte web page: <http://www.mit.edu/~belmonte>

National Institute of Mental Health—Autism Spectrum Disorders: <http://www.nimh.nih.gov/health/publications/autism/complete-publication.shtml>

Autism Research at the National Institute of Child Health and Human Development: <http://www.nichd.nih.gov/autism>

National Institutes of Health—Autism: <http://health.nih.gov/result.asp/62>

National Institutes of Health Autism Research Network: <http://www.autismresearchnetwork.org/AN>

Autism Speaks: <http://www.autismspeaks.org/community/resources>

The Informative Pointing Method for communication by non-speaking persons with autism: <http://www.StrangeSon.com/?page=signup>

Developmental, individual difference, relational-based therapy for autism: <http://www.floor-time.org>

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The information presented here is for general information only, not diagnostic purposes. Consult a physician should you have concerns regarding your child's development.

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