How People with Autism Think

TEMPLE GRANDIN

INTRODUCTION

I am a high-functioning person with autism. I operate a successful livestock-equipment design business and I hold a teaching position at Colorado State University. During the last 7 years I have published and lectured on my experiences with autism. I provide a unique perspective by combining scientific knowledge with my own experiences.

This chapter is divided into five sections: Autism Subtypes, Visual Thinking, Implications of Visual Thinking, Emotions and Empathy, and Sensory Problems and Attention. The first section discusses possible subtypes of autism and how they relate to sensory processing and cognitive sensory and concreteness-of-thinking continuum of autism subtypes. In the second section, I describe my visual methods of thinking, and in the third section I discuss the implications of visual thinking on educational methods, abstract thought, and cognition. In the fourth section, my experiences with empathy and emotion are described. In the last section, I describe where I fall on the continuum of autism and how autism subtypes may affect the efficacy of educational and therapeutic methods.

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AUTISM SUBTYPES

Autism is a heterogeneous disorder with many subtypes, ranging from genius level to very low functioning with mental retardation. Autism diagnosis is further clouded by neurological disorders that produce autistic symptoms such as Fragile X, undiagnosed PKU, tuberous sclerosis, neurofibromatosis, Rhett Syndrome, very high fevers at a young age, or damage to the fetus caused by drug or alcohol abuse. Most of my discussion is limited to types of autism that are not caused by the aforementioned conditions.

Some types of autism are characterized by true problems with concreteness and rigidity of thinking, and in another type individuals may appear retarded due to problems with sensory processing. The rigid thinking described by Kanner (1943) and the theory-of-mind problems described by Frith (1989) may be at one end of an autistic continuum. Autistic persons in this group have true abnormalities in their thinking patterns, which are described in detail in other chapters of this book.

At the other end of the spectrum is Sands and Ratey's (1986) concept of noise confusion and hyperarousal as being the basis of autism. Which is correct? Both are probably correct because each research group was studying a different population. It is like the blind men describing the proverbial elephant. Sands and Ratey (1986) studied an institutionalized adult population of low-functioning individuals. Most research on cognitive processes has been on less severely afflicted individuals who are able to cooperate during testing.

At conferences, I have talked to hundreds of parents and have seen a pattern of autistic subtypes. Autism in which genetics is most likely to be one of the primary causes may be divided into two broad categories that merge together in a continuum. At one end of the spectrum, there are the Kanner/Asperger types described by Kanner (1943) and Asperger (1944), and at the other end of the spectrum are the so-called "low-functioning" types. I prefer to use the term regressive/epileptic. In Figure 8-1, I illustrate a single continuum that encompasses both concreteness and rigidity of thinking and sensory-processing problems. There may be several continuua for autism, such as sensory processing, movement disorders, concreteness of thinking, visual thinking, and other cognitive characteristics. This discussion is limited to rigidity of thinking and sensory-processing dysfunction.

The Kanner/Asperger types have rigid, concrete thinking patterns and definite problems with certain types of cognitive processing. The thinking patterns of classical Kanner-types are beautifully described by Hart (1989).

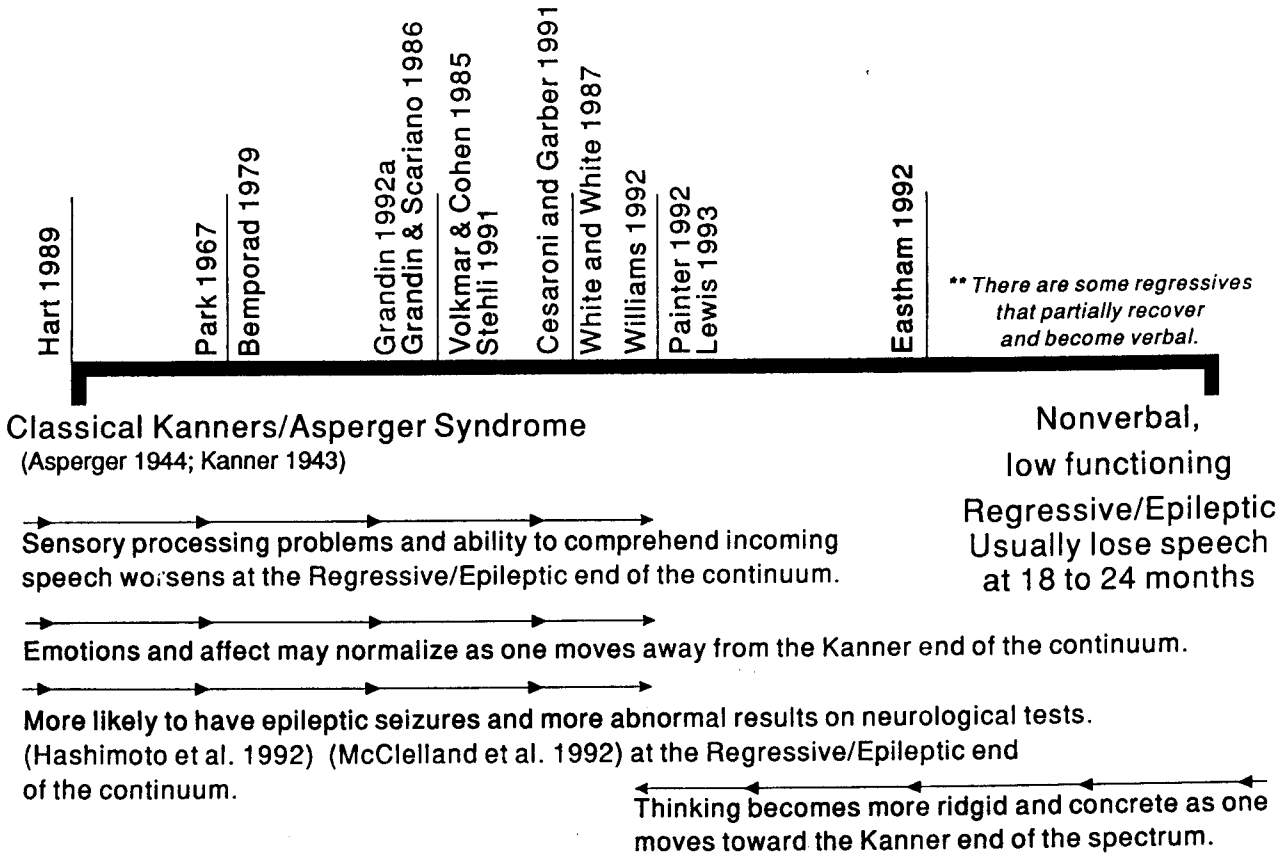

Fig. 8-1. Autistic continuum: Position of people described in published literature on the continuum.

The regressive/epileptics usually have a period of normal development for 18 to 24 months and then lose the power of speech. However, there are some individuals at this end of the continuum who have no period of normal language development. Kurita, Kita, and Miyake, (1992) stated that people with autism who lose their speech tend to have lower mental development. Persons who lose speech at a later age may be even more severely impaired (Volkmar & Cohen, 1989). Gedye (1991) speculated that some symptoms of autism may be caused by frontal lobe seizures, and that these seizures are difficult to detect on a standard EEG test (Gedye, 1989).

In the chapter I wrote for *High-Functioning Individuals with Autism* (Grandin, 1992a), I described problems with sensory hypersensitivity. Low-IQ scores in the regressive-epileptic group may be partially due to sensory jumbling and mixing. It is likely that this group has much more severe sensory difficulties than the oversensitivities that I had to sound and touch (Grandin, 1992a, Grandin & Scariano, 1986). Most Kanner/Asperger types, such as myself, can attend to simultaneous visual and auditory input. As one moves away from the Kanner/Asperger end of the spectrum, sensations from the eyes and ears may mix together (Cesaroni & Garber, 1991; Joliffe, Lakesdown, & Robinson, 1992; Painter, 1992; Williams, 1992). Cesaroni and Garber (1991) described mixing and confusing sensory input from different sensory modalities. One autistic man stated that touching the lower part of his face caused a soundlike sensation. He also reported that sounds came through as color and he theorized that some stimuli act as "triggers" that disorganize processing, similar to epileptic seizures triggered by a flashing light.

Donna Williams (a woman with autism) explained to me that she has problems determining where her body boundary is. The tendency of nonverbal, severely impaired people with autism to constantly touch or tap themselves and objects in the environment may be an attempt to stabilize the boundaries of their own body and other objects. Joliffe wrote that there were no clear boundaries to anything and that she could understand things better through her fingers (Joliffe et al., 1992). Donna Williams, Therese Joliffe, and the cases described by Cesaroni and Garber (1991) may be midway on the autism continuum.

Lewis (1993) described her son, who may also be midway on the continuum. He does not have the rigid thinking of a typical Kanner type and he understands the give and take of conversations. Her son has self-stimulatory behaviors in every sensory modality that indicate serious sensory-processing problems.

Brain autopsies indicate that the different subtypes have a similar pattern of immature development of the cerebellum and limbic system

(Bauman, 1991). Bauman studied both Kanner types and regressive types (Bauman, 1993, personal communication). Although the basic pattern of abnormality is the same for both types, there may be slight variations in the pattern, which could account for more severe sensory-processing problems at the regressive end of the spectrum, and more severe concreteness-of-thinking problems at the Kanner end of the spectrum (Bauman, 1993, personal communication). Cerebellar abnormalities could possibly explain sensory oversensitivity, and brain stem abnormalities may explain sensory jumbling and mixing.

Research with cats and rats indicating that the cerebellum modulates sensory input (Chambers, 1947; Courchesne, Young-Courchesne, Press, Hesselink, & Jernigan, 1988; Crispino & Bullock, 1984; Murakami, 1989) revealed that high-functioning autistic individuals have abnormalities of the cerebellar vermis and smaller cerebellar hemispheres. MRI scans indicated that my own cerebellum is 20% smaller than normal, and a computer genius with classical Kanners had a cerebellum that was 30% undersized.

McClelland, Eyre, Watson, C. Sherrard, & E. Sherrard, 1992) found that lower functioning people with autism have slower electrical transmission through the brain stem compared to higher functioning autistics. Autistics with lower IQs also tend to have small, undersized brain stems (Hashimoto et al., 1992). In the next sections, I describe how rigidity and concreteness of thinking affect learning in people on the Kanner end of the continuum and how sensory-processing problems inhibit learning and language at the other end of the spectrum. An example of a thinking problem in Kanner-type autism is the lack of common sense and ability to generalize. One mother told me that it was impossible to teach her autistic son the meaning of money, even though he had a genius IQ and could program computers. At the other end of the continuum, sensory jumbling and mixing may interfere with learning because the autistic child has difficulty understanding his teachers and how to make proper responses.

VISUAL THINKING

I am a visual thinker, and visual thinking and perspective drawing is often evident at an early age in high-functioning Kanner-type children (Park, 1992). At conferences I have been given drawings in perspective drawn by 7- and 9-year-old autistic children. I have discussed thinking patterns with many highly verbal people with autism. Most of them are visual thinkers, although there are a few who may not be. Virtually everybody near the Kanner end of the spectrum uses visual modes of thought.

The few nonvisual thinkers have very severe sensory-jumbling problems and occupy a midpoint position between the two ends of the autistic spectrum.

In previous publications (Grandin, 1984, 1992a; Grandin & Scariano, 1986), I discussed visual thinking in detail, but I have had some more recent insights. Language and words are alien ways of thinking for me. All my thoughts are like playing different tapes in the videocassette recorder in my imagination. Before I researched other people's thinking methods, I assumed that everybody thought in pictures.

At conferences and during business trips I have asked hundreds of people to allow me to conduct a little test regarding the way they access information from memory. I asked them to access their memories of church steeples or cats. When I access my own memory, I see many different "videos" of specific cats or churches I have seen. Many people reported that they saw a visual image. Further questioning indicated that in most people, the image was very vague and generalized compared to the vivid cat and church "videos" that I imagined. They had a sort of generic, generalized outline of a church steeple or a cat. Like me, most parents of autistic children, artists, and engineers had a strong series of visual images, whereas school administrators and many speech therapists had poor visualization skills. Some brilliant people had no visual thought at all. They accessed their cat concept as auditory or written language. My cat or church steeple concept is based on a series of "videos" of different cats or churches I have experienced. To obtain a good concept of cats or churches, I need to experience many different ones to fill up my "video" library. There is no generalized cat concept. I can manipulate the cat or church "videos." I can put snow on the roof of the church and imagine what it would be like during different seasons. Park (1992) reported that when her autistic daughter painted a picture, her eye acted like a camera.

My mind works like the computer programs that are used to make high-tech special effects in movies. I can take many different bits and pieces and combine them into new images. I use this method when I design equipment in my livestock equipment-design business. The more bits and pieces I have in my "video library," the better I can design equipment. I have videos of many things, such as metal posts, sheet metal, bearings, cattle, motors, gates, and so on. To create a new design, I pull the bits out of memory and combine them into a new piece of equipment. Over the years, I have become better and better at designing equipment because I have a bigger library of "videos." I have a great urge to see and actually operate all kinds of equipment to add more data to my memory. After the machine is designed, I can run simulations under many different conditions and rotate the machine in my head. I don't need computers with

I never thought about this before. I rotate the image in my head by walking around it in my imagination.

fancy graphics programs, because I have a sophisticated drawing and graphics computer in my head. In my imagination I can duplicate the functions of the most sophisticated, computerized virtual-reality systems. However, my mind works slowly. When I draw a detailed three-dimensional drawing, it takes several hours. Attempts to draw rapid sketches result in very crude drawings.

Visualization of Nonvisual Information

I have no language-based memory. When I hear the word *over* by itself, I visualize a childhood memory of a dog jumping over a fence. To store material that I have read, I either read it off a page I have photographed in my memory or I translate the written material into visual images. To retrieve the information, I have to replay the "video." This method of thinking is slower. It takes time to replay the "video" in my imagination. In computer language my memory is like a CD-ROM disc.

Other autistic people have described visual thinking methods for tasks that many people do sequentially. An autistic computer programmer stated that he visualized the overall pattern of the program tree and then he filled in the code on each branch. A composer with autism told me he made "sound" pictures. It appears that his thought processes are similar to mine. He uses bits and pieces of other music to make new compositions. In both of these cases, and my own, a hazy gestalt is visualized and details are added in a nonsequential manner.

I use this same method when I review the scientific literature and do troubleshooting work for meat plants. It is a nonsequential process, which is like trying to figure out what the picture is on a jigsaw puzzle when only a third of the pieces are put together. A piece is put at one corner, then another corner, and then a clump of pieces are put together in the middle. At a certain point, the picture becomes obvious. When I review scientific literature, I look for new patterns. I write the essential findings or "bottom line" of each journal article on a slip of paper. I then pin papers containing related information next to each other on a bulletin board. Patterns will form between unrelated articles. As I become more experienced and obtain a bigger and bigger library of research information in my mind, the physical bulletin board is no longer needed.

Language

If I had to learn a foreign language, I would have to learn it by reading. When I was in Mexico and Iceland, I started to pick up a few nouns from

I do not stand in one spot in my imagination and rotate the image

signs. I have to see the word in print and convert it to a picture in order to store it. The TEACCH program utilizes visual methods for organization of the classroom and educational activities (Mesibov, Schopler, & Hearsey, 1994). In Iceland I visited a classroom where TEACCH methods were being used. Labels were attached to various objects in the room. When I recall the Icelandic word for computer, *tolva,* I immediately see the Apple computer in that classroom with a label taped to it. After I see a word and store it in memory, I can then pick it up in a conversation. The best program for teaching me a foreign language would be careful reading and translation of airline magazine articles that are written in both languages. I would also want to use American movies with foreign subtitles. The phrases on the subtitles could then be associated with the pictures on the film and stored in my memory. I could then use these phrases to communicate. This style of learning may explain why some autistic children use phrases from television commercials in an appropriate manner. During my last trip to Mexico I found that I could pick up the meaning of Spanish words from television commercials. It was much easier to learn from commercials compared to the regular programs. My early attempts to speak Spanish consisted of nouns and simple phrases.

Park (1967) reported that her autistic daughter learned nouns first. Nouns are easy because they can be associated with pictures. Words with no concrete meaning such as *put* or *on* have to be seen in writing in order to be heard or remembered. Park further described how inappropriate words were used. Her daughter said "Dick" to mean *painting.* This occurred because she saw a picture of Dick painting in a book. Pronoun reversal problems may occur because she thinks her name is *you* instead of *I.* Hart (1989) beautifully summarized autistic thinking in a single sentence: "Ted's thought processes aren't logical, they are associational." Visual thinking may explain some theory-of-mind problems described by Frith (1989). Visual associations may explain why one child says "French toast" when he is happy. French toast became associated with happiness because sometime in the past the child had a very happy, pleasant time while eating French toast. Therefore, when he visualizes French toast in his mind, he becomes happy.

IMPLICATIONS OF VISUAL THINKING

Never burden a visual thinker with long strings of verbal information. If verbal directions contain more than three steps, I have to write them down. If an autistic child can read, it is best to provide written instructions that he or she can refer to. Boucher and Lewis (1989) found that written

instructions were superior compared to verbal instructions or demonstration of a task. Some highly verbal autistic persons such as myself can learn reading more easily with old-fashioned phonics (Grandin, 1992a). A visual picture should be paired to each phonetic sound. For nonverbal children with more severe sensory-processing problems, plastic magnetic letters that the child can feel are often helpful. Eastham (1990) taught her nonverbal son to read by holding his hand and tracing his fingers over sandpaper letters. The phonetic sound for each letter was spoken while with his fingers he felt the shape of the letter.

Singing can also facilitate learning. I learned the alphabet by singing it. When I had to recall a specific letter, I had to sing the alphabet song from the beginning until I reached the letter I wanted. I had to start at the beginning of my alphabet singing "video" in my imagination. When I sang the alphabet, I visualized the front porch of our house, because one of the first times I successfully sang the entire alphabet song, I was standing on the porch.

Certain subjects in school were easy because I could convert the material to visual images, and other subjects, such as algebra, were almost impossible. I cannot hold one piece of information in my mind while I manipulate the next step in the sequence. I also mix up the steps because I have many dyslexic traits, such as mixing up similar-sounding words like *over* or *other*. To learn math procedures I have to write down each step.

Williams (1992) had similar difficulties. She had to write down every step. If one little step is left out, the autistic mind can't go to the next step. She needed a visual image written on paper. Written language is often easier for autistic individuals to learn. Word processors and typewriters should be made available to young, autistic children. Typing is often easier than writing because many people with autism have highly illegible writing due to motor-control problems. In my own case, I can express myself better in writing when I want to describe my emotions. For mute, lower functioning children with no ability to hear, speech and language should be introduced through visual methods (Allen & Rapin, 1993). Some of these children may learn to speak after they have learned to read.

Abstract Thought

All abstract thought has to be converted to pictures in order for me to understand. I visualized the Lord's Prayer. "The power and the glory" were high-tension electric wires and a blazing sun. The word *trespass* I visualized as a "no trespassing" sign on a tree (Grandin, 1992a). I visualize

concepts such as justice or truth as pictures of the scales of justice, or a courtroom, and placing my hand on a Bible and taking an oath.

When I was in boarding school, I knew I would have to learn to live on my own. It was impossible for my purely visual mind to comprehend this concept without a physical way of thinking about it. I found a little door that went out on the roof and I would actually walk through it to help me think about learning to be on my own. It was not enough to think about it, I needed to actually walk through the little door. Thirty years ago, I wrote the following in my diary:

> *March 20, 1964*
>
> It was windy that night. I looked up at that door that goes out on the roof. I knew if I went through I'd be going one step beyond where I should go. I walked up to the door, I stood in front of it, I looked out the window in the door, out onto the roof on a cold and windy night. I knew I should not open it. I turned the latches. I could feel the wind trying to push it open. I still stood waiting, watching, wondering if I should open the door—I opened it slowly.
>
> *April 2, 1964*
>
> I think I have answered part of the question. The door goes one step beyond authority. After I went through the door and closed it behind me, authority was on the other side. The door looked different closed from the other side. I could see back through the window back into the house. I stood on the roof looking at the door. That door leads somewhere I don't know. Maybe everybody has to go through that door. There is a time when one must be on his own—then he takes a step beyond authority. In the house looking at the door, I don't know what lies behind that door.

Park and Younderian (1974) also reported the use of visual symbols, such as doors, to describe abstract concepts. Today I look at these diary entries and they seem almost silly. My reliance on concrete door symbols was greatly reduced after I started taking low doses of Tofranil (imipramine) to control my anxiety (Grandin, 1992a; Grandin & Scariano, 1986). When the panic attacks and constant feeling of stage fright subsided, it was easier to think more slowly and logically. Today the new antidepressant Anafranil (clomipramine) is recommended (Gordon, State, Nelson, Hamburger & Rapport, 1993; McDougal et al., 1992). Taking medication has also reduced my tendency to perseverate on one topic, and it has enabled me to cope with unexpected changes in my schedule.

Over the years I have accumulated so much information in my memory that I no longer need concrete door symbols. To understand interactions with people, I compare them to something I have read or experienced. Asperger (1944) stated that normal children learn social skills

instinctively. In autistic people, the intellect is used to learn social skills. Jim, a 27-year-old graduate student, stated that people with autism lack the basic instincts that make communication a natural process (Cesaroni & Garber, 1991). For example, in my equipment-design business, an argument between myself and one of my clients is similar to something I have read about the United States and Europe fighting over trading rights. Over the years I have accumulated vast amounts of information from newspapers and books.

I am like Data, the android man, on "Star Trek, the Next Generation." As he accumulates more information, he has a greater understanding of social relationships. I am a scientist who has to learn the strange ways of an alien culture. Jim Sinclair, a man with autism, stated that he needed an orientation manual for extraterrestrials (Mesibov, 1992). When I encounter a new social situation, I have to scan my memory and look for previous experiences that were similar. I also have, in my memory, information on the social consequences of different methods of response. I then make a purely logical decision on how to respond. As I accumulate more memories, I become more and more skilled at predicting how other people will act in a particular situation. I have learned from experience that certain behaviors make people mad. Sometimes my logical decisions are wrong because they are based on insufficient data.

At the age of 46, I have a vast data bank and I am able to logically determine which people have good intentions and which have bad intentions. When I was younger I was dismayed to discover that some people had very bad intentions. This is something all people with autism have to learn. In business dealings I am now very good at figuring out a person's intentions.

Cognitive Differences

Visual thinking is a true difference in cognitive function. New research findings indicate that verbal thought and visual thinking work via different brain systems. (Farah, 1989; Zeki, 1992). Studies of patients with brain damage indicate that one system can be damaged, while another system may be normal. The brain is designed with modular systems. These systems may work together or separately to perform different tasks. For example, people with certain types of brain damage can recognize objects with straight edges, but they cannot recognize objects with irregular edges. The brain module that recognizes irregular shapes has been damaged (Weiss, 1989). In autism, the systems that process visual-spatial problems are intact. There is a possibility that these systems may be expanded to

compensate for deficits in language. The nervous system has remarkable plasticity; one part can take over and compensate for deficits in language, and another part can take over and compensate for a damaged part (Huttenlocher, 1984). Even though I think visually, I have difficulty recognizing faces. It is also interesting that an autistic woman named Jessie (Park, 1992) and I can both draw fabulous buildings and objects, but we draw very poorly realistic-looking people. Possibly, one visual subsystem works much better than another. Problems with face recognition and drawing of people are probably not related to avoidance of eye contact. Study of normal adults with brain damage from accidents or strokes indicates that face recognition may reside in a separate brain subsystem (Bishop, 1993).

Visual thinking is also associated with being intellectually gifted (Ramo & Rosenberg, 1993). Albert Einstein was a visual thinker who failed his high school language requirement and relied on visual methods of study (Holton, 1971–1972). His theory of relativity was based on visual imagery of moving boxcars and riding on light beams. Einstein's family history included a high incidence of autism, dyslexia, food allergies, high intellectual aptitude, and musical talent, and he himself had many autistic traits. An astute reader can find evidence of them in Einstein and Einstein (1987). Other great scientists, such as Leonardo da Vinci, Faraday, and Maxwell, were visual thinkers (West, 1991).

Intellectual giftedness is common in the family histories of many persons with autism. My grandfather on my mother's side invented the automobile pilot for airplanes, and my mother was an honor's student. One of my sisters is dyslexic and is brilliant in the art of decorating houses. My great grandfather on my father's side was a pioneer who started the largest corporate wheat farm in the world.

Mild autistic traits often show up in parents, siblings, and other relatives (Landa et al., 1992; Narayan, Moyes, & Wolff, 1990). Some of these traits include intellectual giftedness, shyness, learning disabilities, depression, anxiety, panic attacks, Tourette's syndrome and alcoholism (Narayan et al., 1990; Sverd, 1991). There may be an advantage if a person has a few of these traits, such as creativity or high intelligence, but too many of these traits may cause problems (Clark, 1993). I hypothesize that emotions may get more normal as the subtype moves away from classical Kanner's.

EMOTIONS AND EMPATHY

I definitely have emotions, and I was very angry when Happé (1991) implied that I was not able to express emotion. When I was a child and other kids teased me, it really hurt and I became upset. I derive great

emotional satisfaction from my career of designing livestock equipment. When a facility I designed pleases a client, I am happy. Jack, a piano tuner with autism, also stated that pleasing other people is important (Dewey, 1991). If one of my projects fails to work or a client criticizes me unfairly, I become depressed and upset. Jack has similar sensitivities to criticism. He stated, "If I was successful (referring to music composition) I might get some very caustic reviews and I would be crushed because of the way I feel about criticism" (Dewey, 1991, p. 203). I receive great emotional satisfaction by doing something that is of value to society. My work on livestock systems has resulted in improvements in animal treatment all over the United States. It makes me feel good to help other people with autism and their parents. It is also very pleasurable for me to use my visualization skill to figure out a design problem. Exercising my cerebral cortex on an interesting design problem is fun. I have observed that my nonautistic engineering friends also find intellectual use of the brain a very pleasurable activity. Many engineers and scientists value intellect more than emotion.

When important people in my life die, I become very sad, and I often cry during sad movies. If I see someone abusing animals it makes me angry or upset. There are a few areas where my emotions may be different. I am not easily shocked or horrified. If I see something nasty, it may make me angry or sad, but it does not shock me. Another difference is that I use logic and intellect to guide my decisions rather than emotions. I have developed a reputation in the livestock industry for being objective. I can provide an objective evaluation of another scientist's work even if I hate him or her as a person. I have observed that most people have a hard time doing this. I can set my dislike for the person aside and look at his or her scientific work without letting my dislike affect my judgment.

I have learned by interviewing other people that when they think about past traumatic experiences they sometimes become overwhelmed with emotion. When I think about past traumatic experiences, I seldom become upset. The only exceptions are the deaths of my aunt and Tom Rohrer, manager of the local Swift plant, who helped get my career started. I will sometimes cry when I think about their deaths, but I am not overwhelmed. When I experience strong emotion it is powerful while I am actually experiencing it, but it does not become deeply imprinted in my brain. I have no subconscious or repressed memories. I can access all memories and there are no repressed memories due to emotional content that would impede access.

I am successful in designing livestock systems because I can imagine myself as an animal, with an animal's body shape and senses. I am able to visualize myself as an animal going through one of my systems. This "video" is complete with touch, sound, visual and olfactory sensations. I

can play this "video" from two perspectives. The perspective is either me watching the animal, or me inside the animal's head looking out through its eyes. Many systems used in meat plants are designed poorly because the engineers never thought about what the equipment would feel like when it contacted the animal's body. I can imagine how the animal will feel, and set my own emotions aside. I can imagine realistically what the animal would feel because I do not allow my own emotions to cloud the picture.

When I handle cattle in one of my handling systems and the animals remain calm and do not feel pain or discomfort, I have good emotional feelings. If they become agitated or excited, I get upset. Recently, I designed a new restraining chute for holding cattle during kosher slaughter. It is operated with hydraulics. After some practice, I learned to gently ease the animal's body and head into position so that the rabbi could perform kosher slaughter. When the cattle remained calm I felt peaceful. Operating the device gently is an act of kindness and a person has to really love the cattle in order to operate it humanely. Most people who love animals have such a negative emotional reaction to being in a slaughter plant that their emotions interfere with really empathizing with the cattle. As I operated the chute, I concentrated on holding the animals gently and I was very careful not to squeeze them too hard. I wanted to make them as comfortable as possible during the last moments of life. It was like being a hospice worker. When I think about this experience, by replaying it on the "video" in my imagination, I feel good.

Many people in the autism field are somewhat perplexed about Donna Williams's (1992) book, with its poetic, dreamlike descriptions of an abusive family and living on the streets. When I talked to her on the telephone, she sounded completely normal with lots of affect. She did not have the flat monotone of a classical Kanner autistic. Possibly, her type of autism has a more normal mind trapped in a totally dysfunctional sensory system.

SENSORY PROBLEMS AND ATTENTION

In lower functioning (epileptic/regressive) autistics, the poor performance on IQ tests may be partially due to sensory jumbling and mixing caused by miniepileptic seizures between poorly myelinated neurons. McClelland et al. (1992) believe that people with autism have a myelinization defect, which could account for abnormal brain stem-evoked potentials in older autistic children and epileptics. Possibly, poor myelinization

could also account for mixing of sensory input and "blankouts" when autistic persons become excited.

Gillberg and Schaumann (1983) reported on a case of Childhood Absence Epilepsy (CAE, Petit mal) and autistic symptoms. The subjects' EEG normalized and autistic behaviors disappeared after taking the epilepsy drug Zarontin (ethosuximide). Parents of autistic children report that vitamin B_6 and magnesium work best in children who lost speech at 18–24 months. Possibly, it is acting as a natural antiseizure substance. Miniepileptic seizures may cause speech to fade in and out like a distant radio station. One autistic man described how another person's voice faded in and out and that his ears played tricks on him (G. White & M. White, 1987).

Therapy Methods and Subtypes

A teaching program that was successful for me may be terrible for a child with more severe sensory-jumbling and mixing problems. In my book (Grandin & Scariano, 1986) I described how my speech therapist held my chin and forced eye contact. Doing this jerked me out of my world of daydreaming and stereotypical behavior. Intrusive methods may cause further withdrawal in children with more severe sensory-processing difficulties. In a letter, an autistic man wrote me that when somebody looked him in the eye, his mind went blank and his thoughts stopped; it was like a twilight state.

Donna Williams also told me that forced eye contact would cause her brain to shut down. As Donna further described, "their words became a mumble jumble, their voices a pattern of sounds" (Painter, 1992). Donna Williams may be an important bridge of understanding between the Kanner-type autism and so-called lower functioning autism. Her sensory problems are much more severe than mine, or the sensory problems described in Stehli (1991) and Cesaroni and Garber (1991). Talks with hundreds of parents and over 50 verbal autistic people indicate that no other verbal person has described such severe sensory impairments.

Donna explained to me how she can use only one sensory channel at a time. When Donna listens to a friend talk, she is unable to perceive a cat jumping on her lap. If she fully directs her attention to the cat, speech perception is blocked. Visual perception was not fully blocked because she perceived a black shape on her lap. Possibly, the cat was being perceived by one cortical subsystem of the visual cortex. It is well documented that visual perceptions are formed by merging of three cortical subsystems that register, motion, form, and color (Zeki, 1992).

She also told me that she hated the suggestion in my book (Grandin & Scariano, 1986) that teachers should enunciate with lots of intonation. If she listens to intonation, she is not able to hear the words.

Maggie Karen, a psychologist in Hawaii, found that lower functioning children need a quiet environment with a minimum of distracting stimuli. Low-functioning children often respond better to a quiet voice or a whisper, which does not overload their senses. In order to hear words, they need a pause between each word. Karen also found that they could not look at something and talk at the same time. Due to slow sensory processing, they needed to be given more time to respond.

Mesibov et al. (1994) also reported that minimizing distractions assists the learning process. I like lots of visual stimulation, such as bright colors. High-functioning Kanner types may be attracted to visual stimulation that would overload the brain of a low-functioning child. Park (1992) described her daughter's use of vivid colors in her art. Colors and stimulation that are attractive to me may be painful and overpowering to a child with more severe sensory-processing problems. G. White and M. White (1987) and McKean (1993) described how bright colors "hurt" their eyes. Differences in the severity of sensory-processing problems may explain why one autistic child is attracted to the sound of a toilet flushing and another child screams when hearing it.

Sensory integration methods, such as the application of pressure (Ayres, 1979; Grandin, 1992b; King, 1989; Zisserman, L., 1992), are helpful for all autistic subtypes. A sensory-integration method of rubbing her skin with brushes helped to integrate Donna's senses. Sensory processing improved when she was calm and concentrated on one sensory channel.

Attention-Shift Problems

The odd social behavior and rigid thinking patterns of a classical Kanner autistic are probably due to true abnormalities in thinking and cognition, but the problems Donna Williams has may be mainly due to faulty sensory processing and extreme attention-shifting problems. I hypothesize that emotions and thinking gradually become more normal as one progresses away from the Kanner/Asperger end of the spectrum. Donna Williams's book (1992) does not have the rigid, concrete style of classical Kanner autism. On Figure 8-1 she is placed halfway along the autistic continuum between Kanner/Asperger and Regressive/Epileptic. Donna would never make the type of cognitive mistakes Hart (1989)

described in relating that his autistic son put wet clothes away in the dresser when the dryer was broken.

On a radio show, Donna described how her brain can switch back and forth between hearing and seeing without warning. Courchesne (1991) hypothesized that difficulties in shifting attention make it difficult to follow complex social interactions. People with autism may be using a different selective attention mechanism than normal people (Ciesielski, Courchesne, & Elmasian, 1990). Their research has shown that people with autism take much longer to shift between visual and auditory stimuli. Attention shifting may explain some socially inappropriate behavior. Donna explained that it is difficult to look for social rules in her memory at the moment an event is occurring. In some cases, perseveration may be an extreme dysfunction of attention shifting. In her book, Donna describes sewing button holes all over a fur coat (Williams, 1992). She could not stop the response. Afterward, she knew it was wrong.

SUMMARY

Autism is a heterogeneous disorder with subtypes along a continuum ranging from highly verbal classical Kanner's syndrome, to nonverbal regressive/epileptic types with poor receptive speech. The major impairment in Kanner-type autism may be a true deficit in cognition that causes rigid concrete-thought processes. On the low-functioning regressive/epileptic end of the autism continuum, the major deficit may be a totally dysfunctional sensory system where hearing and vision inputs jumble and mix together. The child is nonverbal because he may be unable to make sense from jumbled input.

Most verbal people with autism are visual thinkers. All my thoughts are played as "video tapes" in my imagination. I have no language-based thought. To remember words such as *over,* I visualize a childhood memory of a dog jumping over a fence. When I encounter a new social situation I have to scan my "video tape" library of experiences and find a similar situation for comparison. I then make a logical decision based on previous experiences.

Slightly intrusive educational methods such as forced eye contact worked well for me to jerk me out of my world of daydreaming. However, these intrusive methods may cause a child with severe sensory impairment to withdraw due to sensory overload. I liked colorful visual stimulation, but children with severe sensory jumbling and mixing may make more educational progress if they are taught in a neutral-colored,

quiet environment in which the teacher speaks softly and slowly. In conclusion, intrusive, stimulating educational and therapeutic methods that were effective for me may be detrimental to a child with very severe sensory-processing problems.

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