Title
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Author
Gururangan, Kapil

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Acquired Savantism:

The Genesis of Accidental Genius

Kapil Gururangan

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At age ten, Orlando Serrell was struck on the left side of his head with a baseball; he is able to clearly remember the weather and details about his personal activities for every day since that accident (Hughes 2010, 149). Some elderly patients battling the debilitation of dementia have discovered newfound abilities in music, art, and language (Miller 2008, 8). A former molecular biologist loses her ability to speak but becomes amazingly talented in painting that fuses music, vision, and feeling onto a canvas titled Unraveling Bolero (8). These examples all have one thing in common: the individuals acquire impressive abilities following damage to the central nervous system, predominantly in the left hemisphere of the brain. Savant syndrome is the presence of extreme talent in the wake of profound disabilities and while this normally presents in early development, scientists have observed a fascinating mechanism for the occurrence of savant syndrome after an accident (Hughes 2010, 149). This latter condition has come to the attention of researchers as acquired savant syndrome, the development of savant-like abilities following traumatic injury to the central nervous system. These prodigious abilities were once thought to be purely congenital, but case studies of patients with brain damage have uncovered the possibility that these abilities may not be uniquely inherent to savants, but are also latent in unimpaired people as well. The research of acquired savant syndrome creates the possibility for greater insights into how the human mind functions and develops, as well as how talent and genius can manifest by pure accident. Advances in this field have begun to create new opportunities in science that could expand the potential of the human mind and may one day change the way the world perceives disability and talent.

Neuroscience of Dimensia and Talent

The majority of recognized savants are products of genetic mutation or disabilities in early development; their talent is therefore natural to them and it is difficult to determine exactly what factors may have combined to produce such astounding ability. Researchers have several theories about the underlying mechanism of savant syndrome after observing the neural activity of savants, both congenital and acquired.

The autistic model for savantism stems from the high incidence of autism in the savant population. Nearly half of all savants display some condition that can be classified as an autism spectrum disorder, leading scientists to presume that some facet of autism may also predispose the human mind to the formation of these amazing abilities (Treffert 2009, 2). This model is based on the principle of weak central coherence theory,

Figure 1. "Unraveling Bolero" - Former molecular biologist Anne Adams produced this piece after losing her ablility to speak.

which postulates that the development of talents with extreme obsession is due to an autistic mind's focus on local rather than global processing (Hughes 2010, 149; Wallace 2008, 233). Central coherence is the "driving force to bring together vast amounts of information" to acquire a global understanding of various sources of information (Wallace 2008, 233). Recall John Godfrey Saxe's 19th century poem "The Blind Men and the Elephant," where six men attempt to identify an elephant by its respective parts, each arriving at a different conclusion, one claiming the object is a snake by holding the trunk, while another calls the tusk a spear. This is analogous to weak central coherence – it is the inability to see the forest for the trees, whereas strong central coherence would render someone unable to separate individual information

"...talent and genius can manifest by pure accident."

from the mind's conception of the whole. The autistic mind, and often the savant mind as well, tends to focus obsessively on small packets of information without merging these packets into one body of information. From a neurological standpoint, intelligence and thought patterns are determined by neural connectivity between regions of the brain. Weak central coherence originates from the observed underconnectivity of long-range fibers and the enhanced connectivity within local regions of the brain (Hughes 2010, 149). A savant may be able to delve into his abilities because his mind has more neurons that communicate with each other in concentrated regions that control his talent. While this model may go to great lengths to explain the presence of talent in autistic patients, it only explains half of the savant population effectively. For the other half, research into acquired savant syndrome provided a more general picture of the neural functioning of savants.

Japanese researchers, Takahata and Kato, studied a pool of patients identified with acquired savant syndrome and diagnosed with frontotemporal dementia (FTD). FTD is classified as deterioration experienced in the frontal and temporal lobes of the brain and is not associated with Alzheimer's disease (Lough et al 2001). This disorder has been associated with this acquisition of savant-like abilities and has led to some interesting research in the mechanism of the creation of a savant. Takahata and Kato arrived at two models for acquired savant syndrome. The first model is the paradoxical functional facilitation model, which highlights the peculiar connectivity shown in the autism model as an explanation for the specialized cognitive functions of savants (Hughes 2010, 149). The hypermnesic model proposes that "these skills develop from existing or dormant cognitive functions, like memory" (149). This latter model is the frontier of savant research because it presents the capability for unimpaired individuals to also acquire these abilities. The next relevant issue that followed this research was the process by which these latent functions are awakened in the mind.

The brain operates in distinct regions that control specific tasks and abilities, like emotions, empathy, language, creativity, and calculation. One of the primary distinctions between humans and non-humans is the highly developed frontal and temporal lobes that control language skills, empathy, memory, and creativity (Miller 2008, 7). Further research into the functions of the frontotemporal lobe has shown that there is a significant degree of lateralization in the brain, meaning the left and right hemispheres control different functions (Miller 2008, 7; Perry et al. 2001, 158). The left frontotemporal lobe primarily controls language whereas the right hemisphere dominates visual and spatial relationships. Studies have also shown that in unimpaired people, the left hemisphere is dominant over the right hemisphere, meaning that many of the baser emotional functions of the right brain are modulated by the social consciousness of the left hemisphere (Miller 2008, 7; Hughes 2010, 150). In particular, the relationship to art and creativity is distinct – the right hemisphere is almost fully in control of a human's ability to copy images, pull up internal imagery, and replicate it (Miller 2008, 7). The idea of hemispheric dominance is extremely important to the acquisition of savant abilities. In people who acquire savant-like abilities, an injury to the frontal lobe, particularly in the left hemisphere, preceded the emergence of the skills. The frontotemporal lobe is associated with many of the skills that savants possess, the most important of which is memory (Miller et al. 1996). Degeneration of the lobe leads to varying effects depending on the hemisphere it targets in individual cases.

"...individuals acquire impressive abilities following damage to the central nervous system..."

Dr. Darold Treffert's damage-compensation theory of savantism is rooted in the neural architecture of the brain and its intricate division of function. Treffert argues that damage to the left hemisphere not only removes the right brain from the "tyranny of the left hemisphere," but also allows the right brain to compensate for this damage, leading to the growth of prodigious talent (Hughes 2010, 150; Treffert 2009, 4-5). Savants typically show impairment of abilities that are related to the left hemisphere and boast considerable development in skills that are normally controlled by the right hemisphere (Young 2005, 205). This theory is powerful because it explains the skewed ratio of male and female savants and provides a model that accounts for the changes in the brain's activity following an accident or deterioration of the left hemisphere. The development of the left hemisphere is slower than the right hemisphere, therefore chemical changes in the intrauterine environment during fetal development can impact the two hemispheres in considerably different ways (Young 2005, 206). The higher presence of testosterone in a male fetus can stunt the development of the left brain, leading the right hemisphere to compensate for this damage by increasing its own local connectivity (Young 2005, 206; Hughes 2010, 149-150). This same mechanism of compensation can follow an episode of dementia, as in the case of FTD patients discussed in Miller (2008), or an accident, such as the impact of the baseball on the left side of Orlando Serrell's head.

A Unifying Theory of Savantism

Amidst all of these theories, scientists have tried to piece together a theory that explains savantism as a broad condition rather than as individual cases. The close relationship savantism holds with autism spectrum disorders and the prenatal development of the brain factors heavily into this genesis of accidental genius. The sex ratio and the skills of the savant population result from the differential impact of testosterone on the lateralized left and right hemispheres. The nature of the abilities that savants tend to excel at are right-brain in nature and lend themselves to systemization and memorization (Hughes 2010, 150; Young 2005, 205; Miller 2008, 7; Boddaert et al. 2005, 83). Though savantism may develop after a traumatic accident to the central nervous system, typically through a dementia or injury to the left frontotemporal lobe and a corresponding compensation by the right frontotemporal lobe, there may also be a genetic basis for the syndrome that predisposes a child with developmental disabilities to extraordinary talent. Weak central coherence, a savant brain's ability to maintain the purity of individual sources of information within local neural networks, localizes a savant's talents and roots them in low-level information processing. It is weak central coherence, combined with a savant's intense obsessive practice, which gives rise to these islands of genius.

Figure 2. Dr. Allen Snider with a device designed to simulate the elevated cognitive ability imparted by acquired savantism.

With these foundations for the syndrome, researchers compiled six features of savantism which appear to be largely consistent throughout the body of case studies and neuroscience literature discoveries. They are: testosterone, systemizing skill, heredity, extraordinary memory, interest, and practice (Darius and Valli 2007, 33). The importance of this lowest common denominator for the syndrome provides a baseline for understanding the mechanism by which this condition manifests and the possibility of mimicking its effects in unimpaired individuals to essentially create or uncover talent by freeing the brain from the control the left frontotemporal lobe over the higher-order functions of the mind. This raises an interesting question of whether the prodigious growth of the frontotemporal lobe that evolution has afforded humankind also suppressed skills that were initially less useful to survival, but are now relevant to a modern cultural experience.

Prometheus Unbound – The Dormancy of Greatness

The future of savantism research lies in two camps: the first must continue to refine the causes of this mysterious syndrome while the second attempts to use what the savant mind can reveal about the human mind to uncover new potential in ordinary people. Acquired savantism, the creation of extraordinary talent by accident, may become a sort of lynchpin for both camps because it allows scientists to witness a normal brain become uniquely gifted and perhaps replicate that transition on a patient without incurring the negative disabilities of the syndrome.

Dr. Allan Snyder's research on the effects of repetitive transcranial magnetic stimulation (rTMS) of the left anterior temporal lobe (LATL) both lend credence to Treffert's damage-compensation theory and open the possibility for scientists to uncover these talents in ordinary people (Hughes 2010, 150). However, Young et al. (2004) specified that these improvements may only be possible for some, not all, individuals, just like savant abilities are not present in all autistic patients (221). rTMS is a noninvasive method that works by depolarizing or hyperpolarizing neurons in the brain, allowing a researcher to safely shut off the left frontotemporal lobe to observe the right hemisphere compensate for this reduction in function. Abilities in numerosity, the intuitive understanding of numbers and pattern, painting, and low-level information processing, the mind's interpretation of raw sensory data without contextual encoding or central coherence, have been shown to improve under rTMS. The next step is to expand these experiments to uncover other latent abilities, such as synaesthesia, pitch recognition, musical expression, and prodigious memory.

The savant syndrome is among the great mysteries of cognitive neuroscience and it holds a great potential for new discoveries that could reveal greater depths of the human mind. The creation of prodigious ability by accident in acquired savants speaks to the unknown potential contained within the brain.

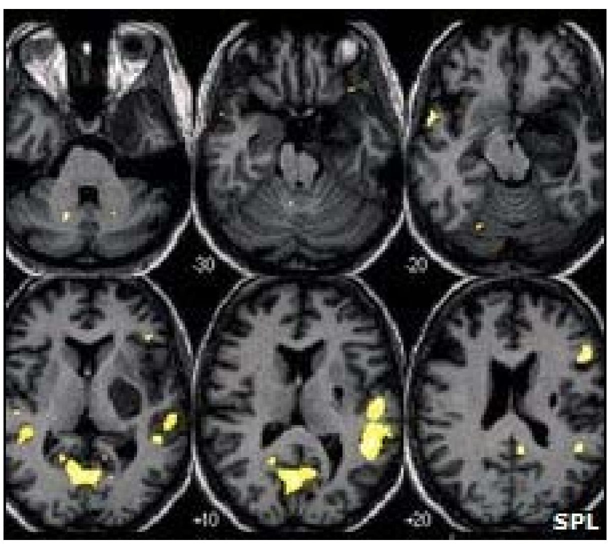

Figure 3. Studies on the brains of accidental savants may hold the key to unlock genius hidden within the human brain.

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