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In *Discourse on Method*, René Descartes immortalized the words "I think, therefore I am." Since then, those five words have been re-used countless times to depict the mind as the seat of rational thought, reason, and consciousness. We at *The Harvard Brain* also applaud the human brain's capacity for logic and complex reasoning; after all, without these attributes, how could we build computers we control with just our thoughts ("Of Men and Machines," p. 15), or design methods to implant memories in mice using light alone ("Here Come the Men in Black," p. 22)?

However, despite the brain's amazing ability to *think*, *The Harvard Brain* is also interested in the opposite: the brain's ability to *feel*. The precise relationship between emotions and the brain has always been a puzzling question, and it remains unanswered even now. Humans experience a range of different emotions every day, and they come to us so quickly and naturally that it is easy to forget their chemical and electrical roots in the brain. Recent research has revealed ways of manipulating emotions by tinkering with the physical brain, such as erasing fear by weakening certain neural pathways ("Forgetting Fear," p. 17) or the ineffectiveness of depression through traditional anti-depressants ("Rethinking Sadness," p. 30). Some evidence even suggests that not certainty may make us happier ("Explaining Away Happiness," p. 28), giving credibility to the old adage "ignorance is bliss."

By integrating the study of the logical and emotional sides of the brain, *The Harvard Brain* brings an interdisciplinary analysis to questions concerning human mind, brain, and behavior. By bringing together the fields of neurobiology, psychology, computer science, human evolutionary biology, linguistics, anthropology, and economics, we aim to tackle a variety of fundamental questions in novel ways. Such fields have shed light on such diverse topics as music's role in healing the psyche and the body ("Surround Sound," p. 9) the development of genius ("Is Genius Born or Made?" p. 24) and the role of human pheromones in attraction ("Human Pheromones," p. 13). Together, these fields offer collective insight into the human quest of understanding our species.

*Sincerely,*

Amy Chen
Sarah Zhang
Buzz Buzz! A Fly’s Contribution to the Science of Hearing

When you are asked to imagine a master of intercepting communications, what comes to mind? Spies, hackers, perhaps the FBI? Surprisingly, perhaps the greatest master of them all is not even human. The female Ormia ochracea fly has developed incredible hearing mechanisms in order to intercept the call of a male cricket. Once the female hones in on the cricket’s call, she injects her eggs into his body, which hatch into larvae and eat their way out of the cricket. Since finding the cricket is no easy feat, the incredibly developed hearing systems of the Ormia fly are used today as an inspiration for human hearing aids.

In order to calculate the direction of a sound’s source, our neural circuitry makes use of the differences in time it takes for a sound to reach both ears, and the difference in intensity of the sound in both ears, termed the inter-aural time (ITD) and inter-aural intensity differences (IID), respectively. The Ormia fly’s greatest hearing challenge is that its ears are very close together, making it very difficult to discern differences in the timing and intensity of sound reaching each ear. Therefore, the fly utilizes mechanical and neural amplification to resolve ITDs 1000x smaller than a human can, which makes up for the close proximity of its ears (Robert, 2002).

Recently researchers have developed miniature directional microphones inspired by the Ormia fly’s ears that can be used in hearing aids and other technologies. Two diaphragms capture sound vibrations and are joined by a bridge that flexes like the bridge between the two tympana in the fly’s ears. As in the fly, a sensor measures differences in the amplitude and phase between the two vibrating membranes, resulting in directional information about the sound. The next step will be translating the fly’s neural circuitry into efficient sound processing algorithms (Miles, 2009).

- Hanna Retallack

References

How to Make Time Fly

You’re sitting in class, and the professor’s droning on again. You glance at the clock. Check your email. Scratch an itch. Scribble down some notes. Look at the clock again – what, it’s only been five minutes?

Einstein said it best when “explaining” relativity: “Put your hand on a hot stove for a minute, and it seems like an hour. Sit with a pretty girl for an hour, and it seems like a minute.” We consistently perceive time in relation to the events happening around us. In fact, on a personal scale, we have no real way to examine the passing of time other than glancing at our watches or clocks – or perhaps the location of the sun relative to the earth. Human perception of time is a peculiar phenomenon, one that is very subjective to each person at the present moment.

In a recent study published in Frontiers of Human Neuroscience, researcher Mark Wittmann used fMRI to look for what parts of the brain are responsible for this elasticity in the perception of time. Objects that loomed or receded, compared to static objects, specifically activated two parts of the brain: the anterior insula and anterior cingulate cortices, suggesting that time perception is influenced by surprise and fear.

Time is a dimension of the universe that requires a great deal more thought and study, but Wittmann’s results nonetheless elucidate a certain and peculiar truth: our biology determines our perceptions and potentially our fears.

-Nisha Deolalikar

Reference
Lighting Up the Brain

Researchers at MIT have recently developed an innovative and potent way to study brain activity. By genetically engineering neurons to express light-activated proton pump proteins, researchers of the Boyden lab were able to selectively silence neural populations in the mouse cortex by shining different colors of light on them. The two genes that were used, Arch and Mac, are naturally found in bacteria and fungi and express a class of light-activated proteins. Shining light on neurons that express these genes activates these proton pump proteins that effectively inhibit neuron activity by decreasing the voltage in the neurons and preventing them from firing. Arch and Mac are able to silence neurons in response to different colors of light: Arch in yellow light and Mac in blue light. This color specificity will allow researchers to shine different colors of light on the brain to silence specific regions where neurons are expressing one of the two genes. This method is an improvement upon previously established optogenetic techniques and may lead to more effective ways of studying the role of specific neuron populations, such as those involved in Parkinson's disease and epilepsy.

The Arch and Mac genes respond to light accurately and quickly, in addition to allowing reversible silencing of regions of the brain in which they are expressed. With further studies and tests to confirm the efficacy of the method in higher level organisms, this technique may very well lead to a better understanding of human diseases in the brain.

To read more about light-activating neurons, see page 22 for “Here Come the Men in Black: Writing Memories with Light”

Talking to the Comatose

If a person can’t move or talk, how do you know what he’s thinking? This is a problem faced everyday by doctors diagnosing comatose patients. Patients are typically diagnosed at the bedside via a series of neurological exams that assess their level of awareness of their environment.

One study published in the New England Journal of Medicine demonstrates the flaws of our current methods of diagnosis. In this study patients that had been previously diagnosed as vegetative or minimally conscious were monitored with functional MRI (fMRI) while being asked to imagine different scenarios. The patients were asked to either imagine playing tennis — a motor task — or to imagine walking through the streets of a familiar city or their home — a spatial task. In healthy people, each of these tasks activates a characteristic part of the brain, and the fMRI allows scientists to see which areas of the brain are active. It was found that five of 54 presumably vegetative patients were able to control their brain activity.

The team took the experiment a step further by showing that the fMRI could serve as a medium for communication. One patient was instructed to imagine playing tennis if the answer to a question was yes, and to imagine his house if the answer was no. By doing so, he was able to answer correctly five of six questions. This research opens up the possibility that these patients may be able to participate in decisions about their medical care and end of life, although their judgment on complicated issues is also questioned because of their inherent degree of brain damage. Even if they say yes or no to a simple question, one cannot be sure that they retain enough cognitive ability to respond to more complicated questions such as those regarding treatment or euthanasia.

While this study is promising, there is one major drawback. fMRI is extremely expensive. For this reason researchers are now working on developing alternative methods based on Electroencephalography (EEG) devices, which are much cheaper and more portable than fMRIs.

Reference
I want you to smile—and please keep smiling while I tell you this joke:

“What happened to the peanut that was walking through the park at night?

It was assaulted.”

Get it? Now, imagine I told you the same joke, but asked you to frown instead. What do you think would have changed? Research shows that while smiling, you would get the joke faster (Niedenthal, 2007).

Now, consider this scenario: I hand you a warm cup of coffee and introduce you to someone you have never met before. After you have chatted for a while, I ask you to tell me your opinion of that person. If I had handed you a cold beverage, do you think you would form the same opinion of that person? Most people intuitively sense that they would—after all, what difference could a cup of coffee make? Surprisingly, a study conducted by Williams and Bargh (2008) found that people who held a cup of hot, as opposed to iced, coffee rated a target person as being more generous and caring—in other words, “warmer.”

These two examples show that the body has a surprising degree of influence on the mind, a connection that has only recently been studied. The typical view of human cognition says that higher order thinking is akin to the operations of a computer and that these operations are independent of the conditions of the body, which are called somatic states (Goldman & de Vignemont, 2009). However, situations such as those described above point to a different understanding of the mind: information processing is indeed influenced and constrained by input from the body. This new theoretical view, known as embodied cognition, enables us to examine how somatic states can influence the processes of the human mind.

Throughout history, the brain has been likened to a number of different material objects (e.g. a hydraulic machine, a hologram, a computer). Rene Descartes saw the brain as a pump that circulated an “animating fluid” throughout the body, while the mind was conceived as completely separate, interacting with the body through the pineal gland. Descartes’ model of separated mind and body remained the dominant model up until the 1950s, when the metaphor of the brain as a computer and the mind as software started to take hold (Gibbs, 2006). According to this model, information is taken in via the senses and stored in memory in the form of abstract symbols that are processed and altered by the functions of the brain. In other words, the mind is essentially comprised of patterns of information, “software,” that could theoretically be instantiated in any “hardware,” be it neurons or silicon chips (Niedenthal, 2007). This paradigm only reinforced the belief in a sharp separation of the mind and the body—the mind could be described, in theory, without any reference to the body.

Beginning in the 1980s, researchers began to question the computer and software model of the relationship between the brain and mind (Bennett, 2008). New research indicated that the brain does not actually process information like a computer, but through a much more complex process. This new research stressed that the physical properties of brains and neurons actually have a substantial role in our thinking and reasoning. Once this conclusion was reached, it was not hard to imagine how other facts about our bodies could influence our mental states. In 1995, proof of such an influence came when Fadiga et al. discovered systems of “mirror neurons” in the brain (Fadiga et al., 1995). These neurons fire when we see someone else performing an action, or even hear the action being described to us, as though we were the ones perform-
ing the action ourselves. For example, when you see someone moving his arm, the neurons in your brain responsible for moving your arm in the same way are activated, even when you make no movement. These neurons imply that the brain is designed in part to “mirror” the pattern of neural activation responsible for the actions of those in our surroundings—a major challenge to the notion that we can understand the mind without reference to our bodies, or even to those around us. The insights of the 1980s and the discovery of mirror neurons have inspired much of the new research regarding the interconnected nature of movement, feeling, and thinking.

Researchers have recently found that the body can be involved in shaping preferences. A study in 1993 examined how subjects’ feelings about pictures can be influenced by simultaneous movements in their arms. Subjects were shown a set of Chinese ideographs and were asked to either push down or pull up on a table in front of them. The researchers found that the subjects preferred the pictures that they saw when pulling the table towards them to the pictures they saw while asked to push away (Cacioppo, Priester, & Berntson, 1993).

The state of the body can also influence the way we process incoming emotional information. Stepper and Strack (1993) had participants adopt either a confident body posture (in which the shoulders and head were held high and back) or a less confident body posture (in which the shoulders and head were slumped). They were then told that they had done well on an achievement test they had completed earlier. Those who received the good news while slouching were less proud of their achievement and reported being in a worse mood than those who were told whilst in the upright or confident position.

Some even argue that the deepest properties of our thinking, those fundamental to our human identity, are rooted in our bodily experiences (Bennett, 2008). Berkeley linguist George Lakoff believes that our number system is based on the fact that we are bipedal and calculate distances in discrete steps. He believes that if we moved in a different way, by slithering or via flight, then counting might be very different.

These preliminary studies and theories indicate that there is a closer, more intertwined connection between mind and body than we had previously guessed. The next step is to find out how this connection operates. The field of embodied cognition is still nascent, and critics object to the lack of a sufficient explanation of how it functions, beyond mere correlation. When proponents of the theory say that cognitive processes arise from our bodily states, what do they mean? Understanding the evolutionary roots of embodied cognition and its neurobiological underpinnings could give us much greater insight into the mechanism that connects the body and the mind. Such a system might be adaptive, or it could be the by-product of overlapping neural pathways in the brain. Perhaps the newer, more complex, systems of our brain are built ‘on top of’ lower-level somatosensory systems and this Lego-like cognitive architecture explains why our cognition and sensation might be so intertwined. A scientific consensus on a fully functional model of the system has yet to be formed, but we know that at least some part of our perceptions are influenced by the body’s input to the brain at the time when the information-processing is required. Therefore, next time you go on a date, you and your partner may want to go to a coffee shop and order something warm.

References


Music deeply affects us, emotionally and psychologically. Just look at the visceral fist-pumping of a rock concert attendee or the tears evoked by a delicate violin solo. Indeed, we know what Beethoven meant when he said “music is the mediator between the spiritual and sensual life.” Yet for all of our appreciation, we often think of music from a strictly historical or sociological perspective—since we label it as an art, we suppose it is something only to be appreciated aesthetically. Only recently have researchers begun to probe the effects of music on the human brain.

At the biological level, music affects the mind in a quantifiable and measurable way. To uncover the mysterious link between music and the brain, researchers have studied how the brain processes music and how it is affected by musical stimulation. With sophisticated brain-imaging techniques like fMRI, neuroscientists have begun to make reasonable hypotheses about music’s role in the brain. Perhaps most surprisingly, recent models have suggested that music affects the entire brain, rather than specific regions or sub-regions.

Music perception involves several pathways in which sound passes through the ear and eventually reaches the brain. Generally speaking, all sound is processed in the auditory pathway, which starts at the cochlea, continues through the eardrum and the inner ear, and reaches the primary auditory cortex. After this initial processing of basic sound elements, auditory networks of various regions of the cerebral cortex come into play to process all of the complex sound information that eventually coheres as the music we perceive.

As with most information-processing in the brain, simpler discriminations made in primary cortices are fed forward into other parts of the brain for more complex processing. With music, basic discriminations of frequency, pitch, and volume are made in the primary auditory cortex (Warren, 2008). This basic information is then fed-forward into more complex processing, such as instrument-discrimination, melody/harmony recognition, etc. From here, musical information is sent to other centers, such as emotion and cognitive faculties (Warren). In this way, music appears to parallel the processing of language, whereby discrete stimuli elicit complex, abstract representations in accordance with basic, hierarchical rules.

Clearly, music provides extensive stimulation for the brain—it has even been shown that music may stimulate areas of the brain important for seemingly unrelated tasks such as learning and memory (Warren; Rauscher, 1997). Given the pervasive influence of music on the brain, it would make sense that music might bear interesting relationships to a wide spectrum of phenomena—and indeed, this is what recent neuroscience has suggested.

For example, music seems to have a unique relationship to Alzheimer’s disease, a disorder characterized by progressive loss of neurons and synapses in the cerebral cortex that leads to, most prominently, memory loss, as well as dementia, and ultimately death. Samson et al. of France conducted a study in a French residential home for the elderly in which a group of patients with varying degrees of Alzheimer’s were tested for their abilities to learn new songs. Each week, the patients learned a phrase of a song in a one and a half hour session with the goal of learning a 10 line song in about 8 weeks. These Alzheimer’s patients were able to remember the song and even sing it up to 4 months after the learning sessions. Amazingly enough, they acquired a new long-term memory of the song, even though they had no memory of the weekly learning sessions themselves.

To further test the results of their experiment, the researchers conducted a second study in which six patients with moderate to severe Alzheimer’s were exposed to three popular songs with lyrics, three excerpts of instrumental film music, and three short stories. After 10 sessions in which the patients were exposed to these auditory stimuli, they were presented with a variety of old and new stimuli of the same repertoire and tested for their level of familiarity. Confirming their previous results, Samson and colleagues found that the patients were more familiar with old rather than new songs and instrumental excerpts, while the difference in familiarity with old and new short stories was not statistically significant. Even though these Alzheimer’s patients had severe memory and language deficits, the fact that they were able to learn and sing new songs suggests an astonishing connection between music and memory (Samson et al., 2009).

Music provides much more than just leisurely pleasure and entertainment, but what does this all mean? Is music really something that is wired into our brains even before birth?
Music also has an apparent ability to heal. For example, in “The Power of Music,” Oliver Sacks tells the story of one of his patients at a severe stage of postencephalitic parkinsonism, a disorder characterized by the degeneration of neurons in the substantia nigra leading to abnormalities in movement such as rigidity and tremors. This patient would be doubled over making rigid jerking movements, and upon hearing music, she would be freed of all of her movement restrictions and easily flow and dance to it (Sacks, 2006).

Researching is beginning to crack the puzzle of music’s powerful effect on patients with movement disorders. In a study on rats, Sutoo et al. discovered that exposure to music increased blood calcium levels, leading to increased dopamine synthesis in the brain (Sutoo et al., 2004). Dopamine is a neurotransmitter involved in various functions of the nervous system. The lack of sufficient dopamine synthesis by dopaminergic neurons is one of the causes of Parkinson’s disease. These findings suggest that music may effectively treat the symptoms of diseases that involve dopamine dysfunction.

Given the effects that music seems to have on such diverse organisms, how do we assess its significance? Recent studies suggest that even the fetus can perceive and respond to music. The fetal auditory system reaches functional maturity by the twenty-fourth week of gestation, suggesting the importance of auditory function in the fetus (Koelsch et al., 2005). The documentary The Music Instinct: Science & Song explores this hypothesis. In the film, Dr. Woodward of the University of Southern California conducted an experiment in which a hydrophone—a microphone originally designed for use underwater—was inserted into the uterus of a pregnant woman to capture any elicited responses from the fetus. When Woodward began to sing, the unborn child unmistakably smiled. These fetal responses to music are varied—fetuses have been observed moving their hands to the music as if they were conducting or dancing in an extraordinary way.

In some ways, Woodward’s experimental results leave us with more questions than answers and indicate the need for future research. Given that even fetuses know to instinctively react to music, is music somehow innately programmed into our brains? Or is their reaction merely the effect of something else to which they have innate preference, such as rhythm (as in speech) or relations among pitches (as in the aural detection of predators)? Fetal responses to music have not been studied in great detail, and further experiments may shed more light on the ability of fetuses to distinguish different types of auditory stimuli and the role of music in development.

Music provides much more than just leisurely pleasure and entertainment, but what does this all mean? Is music really something that is wired into our brains even before birth? If so, then what exactly is the evolutionary advantage it provides to human beings? In terms of music and evolution, there are different theories and hypotheses. Charles Darwin once argued in his book The Descent of Man that music has evolved as a way for males to charm the opposite sex. Other believe that music has no evolutionary purpose at all. For example, Steven Pinker has famously referred to music as “auditory cheesecake” in his book How the Mind Works. As mentioned previously, music perception involves many parallels with language, which supports the hypothesis that music is epiphenomenal—that is, a chance side-effect of something that was evolutionarily beneficial, in this case language. However, some believe the opposite is true: music was a key contributor in the development of language itself (Koelsch et al., 2005). As more studies are done on the impact of music on the human brain and its role in development, researchers may collect more conclusive evidence that may help us better understand why we were endowed with the ability to appreciate music.

REFERENCES

Growing up, kids are bombarded with a flood of warnings about wearing their helmets and protecting their noggins. The rationale is simple: brain injuries are worse than other injuries because, unlike the skin that regenerates if you fall and scrape your elbow, neurons don’t grow back. According to what has long thought to be true, the human brain is static on a cellular level. The brain cannot be repaired in response to injury. Neurons cannot regrow or regenerate. When you kill a cell in your brain, that’s it. Perhaps function will be minimally affected; perhaps other neurons will step in like good neighbors and take on the responsibilities of the deceased cell; or perhaps the injury will be debilitating. Whatever the case, everything that we have been taught so far lends itself to a model of the adult brain in which a mass of connections is established in the womb, only to be pruned away by development and time.

However, that circuit board model of the brain isn’t quite right. Logic hints at the fallacies of thinking about the brain as a mass of trillions of neurons that cannot be regrown after birth. After all, we are capable of learning new things even up until old age, which means that the brain must be establishing new connections. We heal in strange ways, rearranging circuits to minimize loss of function when parts of the brains are injured. We can imagine and dream and remember, all things very much a product of our experiences that are constantly changing throughout our lives. So not only does the brain change, but it changes a lot. Science has seized upon one of the most interesting aspects of this debate: whether new neurons can grow after birth.

Interestingly, it seems that there are parts of the adult brain where regeneration occurs even in adulthood. We are currently aware of only two areas in which this neuronal regeneration happens: a specific region of the hippocampus and the olfactory bulb. The regions seem random and, maddeningly, there are very few answers available for why they were endowed with this seemingly incredible ability. The olfactory bulb, responsible for the hu-
man sense of smell, is the more puzzling of the two. In the past 20 years, studies have demonstrated the potential regenerative capacities of OECs, olfactory ensheathing cells (Radtke & Wewetzer, 2009). OECs are a type of glia, which are the support cells that both protect and supply oxygen and nutrients to neurons. It’s hard to see an evolutionary reason for regeneration in the olfactory system rather than any other system that might benefit from regeneration of neurons, such as the prefrontal cortex.

However, even though the reasons for olfactory neuron repair remain unknown, we can still harness the power of regeneration exhibited by these neurons to treat human disease. Research showed that transplanted OECs could promote regeneration of central nervous system (CNS) cells in rats. OECs are more potent than other types of glial cells because they appear to cause less scarring after transplantation, which can otherwise prevent neurons from re-establishing their connections after an injury. The ability of OECs to circumvent major scarring has immense potential. Within the human brain, so critical to our own species and yet so unforgiving post-trauma, OECs could offer the promise of neural repair, even after significant injury.

As exciting as it is to ponder these possibilities, the road to human therapy is still long. Much of the evidence found in vitro (in a cell culture) has been impossible to replicate in vivo (in a living animal), further frustrating scientists in the therapeutic application of OECs. Many critics argue that the relative potency of OECs as compared to their close cellular relatives, Schwann cells, has yet to be established. The majority of research so far has been done with rat and dog cells, both of which come from organisms with a more highly developed sense of smell than humans and whose OECs may have species-specific properties. Scientists are not anywhere close to studying the effects of human OECs implanted in the human brain. One promising study, though, has shown that human OECs can proliferate and grow in the injured spinal cords of rats (Deng 2006).

The concept of regeneration in the adult brain is certainly thrilling. Just as stem cell research has revolutionized how researchers develop disease therapies, OECs make us wonder about possible applications to human disease, as well as other neurons that might regenerate in some yet undetected fashion. Though parents aren’t likely to stop reminding kids to wear their helmets any time soon, OECs may lead to important insights into neural development.

References


Don’t Hug it Out!

It has long been a mystery why people with fragile X syndrome, a genetic defect that is the most likely cause of autism and other forms of mental retardation, dislike hugs and other forms of physical touch. New research from Northwestern University Feinberg School of Medicine suggests that there is delayed development of the sensory cortex (the part of the brain that reacts to touch) in people with fragile X syndrome. Such a delay might trigger a snowball effect and create more problems in the circuitry of the brain later in development.

Understanding how and when the brain is affected in fragile X syndrome could pave the way for therapy designed to fix incorrect development. During development there is a critical period in which the brain is very malleable, or plastic, and is undergoing considerable changes. Northwestern researchers worked with a mouse model of fragile X and found the development of synapses, a space between two neurons that allows for their communication, was impeded in the sensory cortex. The critical period is thus critical in more ways than one for patients with this syndrome: it could provide a window of time in which medical intervention can correct synaptic development and some of the problems caused by the syndrome.

Reference:

Update by Bay McCulloch
human
pheromones:
myth or reality?

by Angela Yuen

Increased sex appeal for just $75 a vial! Sound familiar? Hundreds of advertisements in magazines and on the TV claim to hold the secret to synthetic “pheromones” that will improve your sex life. Take one popular brand of pheromone consumer product: Athena Pheromone. This particular brand offers to “let the power of human pheromones increase the romance in your life, with just a few dabs of our colorless, odorless liquid every other day!” Could this miracle ointment that promises to wash away all romance romantic woes be too good to be true?

For decades, the existence of detectable human pheromones has been a topic of much controversy and debate. Most of the doubt focuses on the vomeronasal organ (VNO), a prominent portion of the olfactory system where pheromone receptors in mammals are believed to be located. Several studies have concluded that the adult VNO in humans is largely nonfunctional, consisting of only a few neurons and mostly epithelial cells with no sensory function. A nonfunctional VNO in humans would therefore rule out the possibility of human pheromones being detected. That is, if pheromone receptors are indeed only centralized in this area.

However, there is also much evidence to support the claim that there must be some level of unconscious detection of chemical signals between human beings. For example, it cannot possibly be a mere coincidence that females who live together tend to synchronize their menstrual cycles. Indeed, Ferdenzi et al found that olfactory perception in females is highly variable, depending on what phase of the menstrual cycle they are in or whether they have taken oral contraceptives (2009). Females who were ovulating were also most sensitive at distinguishing between male odor intensities. If their natural menstrual cycle was disrupted by the synthetic hormones found in oral contraceptives, they were unable to detect male odor differences.

This finding, that females can discriminate between different types of male odors, is consistent with the results from a famous study by Wedekind et al. Wedekind and his colleagues found that females are more attracted to male body odors with the most genetically varied histocompatibility complex, but only if they are not on oral contraceptives. It makes sense that this ability to distinguish odors is present during a woman's most fertile period, as human social odors are believed to serve as inherent guidelines to prevent inbreeding and introduce immune diversity.

In addition to the ability of females to discriminate between male odors, it appears that males can directly influence the onset of menstruation in females. According to a scientific review by Burger et al, results from mammalian studies show that puberty in females is delayed by pheromonal exposure to adult females and accelerated by exposure to adult males. Throughout the years the age of menarche, the onset of menstruation, has decreased consistently. Perhaps the change in social and domestic structures worldwide have contributed to this trend—more women have entered the workforce in the current era, while men have union-reduced work hours per week and are a more prominent presence in the home. Hence, the culprit of earlier menarche could simply be less mother time and more father time with their children.
Considering that pheromonal signaling in animals is usually useful for mate preference and selection, it is also interesting to note that sexual orientation in humans is correlated with the types of odors they find more attractive. Through PET scan imaging, Motofei et al. studied the activation of the hypothalamic nuclei, which responds to different types of pheromones. Motofei and his colleagues found that both heterosexual women and homosexual men respond to male pheromones, while heterosexual men and homosexual women respond to female pheromones (Motofei, 2009). Clearly, the kind of pheromone one responds to can drastically change mate preferences.

Given the wealth of studies that demonstrate how humans respond to pheromones, we must ask: how are these effects possible if humans do not possess a functional VNO? A recent study by Liberles et al. could shed some light on this dilemma. The researchers uncovered the existence of trace-amine associated receptors (TAARs) located in the olfactory epithelium, which have ligands that correspond to established pheromones. For example, TAAR4 recognizes b-phenylethylamine, a compound whose elevation is correlated with increased stress in both rodents and humans. Since TAARs are prevalent in the human olfactory epithelium, they may provide an alternative pathway for some level of pheromonal signaling detection, even in the absence of a functional VNO.

Ultimately, the manufacturers of human pheromones may not be completely wrong. After all, there is clearly some level of subconscious human chemical signaling involved in our day-to-day interactions, whether it be with our parents at home, the girls you live with, or with our many peers of the opposite sex. Although it is doubtful that any small dab of synthetic “pheromone” could attract several men in the same day, it is possible that our own subconscious processing of pheromones help dictate whom we are attracted to. But consumers beware: men and women attracted to a synthetic pheromone may end up being only attracted to the synthetic pheromone itself, rather than your own natural essence.

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Neurorobotics and the Dawn of the Cyborg-Era

By Jerry Tullo

While neuroscience and robotics may seem like disparate fields, the same basic electronic principles underlie any circuit, whether that circuit is found in a brain or a computer. Consider this: The human nervous system is a network of electrical signals designed to sense, compute, and respond to the environment around us. Robots and computers also sense, compute, and respond via electrical circuitry. From this perspective, the only difference between human cognition and robot cognition is whether the electrical currents are sent through neurons or wires. In fact, all it takes to connect these two information networks is a few electrodes. Thus, the field of neurorobotics has emerged, fusing neuroscience and robotics in groundbreaking experiments with provocative implications.

When the nervous system of an organism is connected to a computer, the connective device is known as a brain-computer interface (BCI). A BCI can go in two directions: the brain can send signals to the computer, or the computer can send signals to the brain.

Imagine the following scenario: A quadriplegic sits in his wheelchair. There are wires coming out of his brain, connected to a computer in front of him. He thinks, and the cursor on the screen moves. By interpreting electrical potentials in his brain, the computer can understand exactly where the man wants the cursor to move—all it takes is a little willpower and thought. This may sound like a sci-fi story, but it is the result of real scientific experiments conducted by the bio-tech company Cyberkinetics together with Brown University's Department of Neuroscience. In fact, Braingate, as the brain implant system is called, is now undergoing clinical trials.

In a similar experiment, researchers at Duke University successfully linked the primary motor cortex of an owl monkey up to a robotic arm that can be manipulated by the monkey's thoughts. In both of these experiments, the brain-computer interface receives signals known as pre-movement potentials. Pre-movement potentials are signals in the primary motor cortex that represent the initiation and planning of an action, so they occur before the movement is executed. By analyzing these electrical patterns, the BCI is able to understand exactly what the monkey wants its robotic arm to do. Because the electrodes are wired to pre-movement potentials, upstream of where they would normally activate motor neurons in the monkey's own arm, the primates eventually learn to operate the robotic arms while bypassing their own arms entirely. The monkeys demonstrate a remarkable degree of dexterity when reaching, grabbing, and bringing food to their mouths. (YouTube it!) The hope is that, eventually, this research will lead to technological breakthroughs that allow amputees and paraplegics to resume a normal life.

As always, with new technology comes new risks. To some, the BCI represents the hope for a normal life, but to others, the implications are more sinister. An experiment dubbed “robot-rat” demonstrates a reversed BCI, where the computer controls the brain. Researchers fitted a rat with three electrodes that protrude into its brain. One electrode stimulates the pleasure center, while the other two stimulate the primary sensory cortex on the left and right sides. These electrodes send artificial signals to the rat, telling it that either its right or left whiskers are touching something. The rat, thinking it has hit a wall, will turn away from the whiskers that are “ticked” by the electrode. A remote control with three buttons, turn-right, turn-left, and “good boy,” is essentially all that is needed to turn a living creature into a remote-controlled rodent with no visible signs of any lack of free will. This BCI essentially allows humans to control rats by simply wiring them up to a computer.

This thought is worrisome if one examines the motivations behind this research. While the scientists intend for their research to help paralyzed patients and amputees, some of their funding comes from organizations with unknown long-term intentions. The experiments discussed were partially funded by the research and development sector of the United States Pentagon, also known as the Defense Advanced Research Projects Agency (DARPA), which intends to use BCIs to enhance the capabilities of modern-day soldiers. DARPA's Brain-Machine Interface Program aims to “create new technologies for augmenting human performance through the ability to access codes in the brain in real-time and integrate them into a peripheral device or system operations… and implement wireless interfaces to extract necessary control commands from the brain” (Evans, 2004).

For the fiscal year of 2009, DARPA allocated 4 million dollars to Silent-Talk, a program that aims to “allow user-to-user
communication on the battlefield without the use of vocalized speech through analysis of neural signals”, according to Katie Drummond’s May 14, 2009 article on Wired Magazine. Another 4 million dollar grant was given to the University of California to investigate computer-mediated “synthetic telepathy”. This research aims to “detect and analyze word-specific neural signals... [and] see if the patterns are generalizable.” These word-specific neural signals are what scientists call sub-vocalization potentials. Sub-vocalization potentials are to speech as pre-movement potentials are to movement. Sub-vocalization can be evoked by “saying” a word in one’s head without actually moving the vocal chords or making any sound. We create sub-vocalization potentials whenever we think aloud to ourselves, or read a book. The military hopes that just as monkeys are able to control robotic arms based on pre-move-ment potentials, soldiers will transmit ideas based on sub-vocalization potentials. But there is real danger that, as BCI technology advances, the reverse could occur—in this case, perhaps the behavior of soldiers could be controlled from remote stations. While such a scenario is still a distant possibility, there is some cause for immediate concern: DARPA’s Brain Machine Interface Program operates with little ethical oversight, and like many military initiatives, the details are secret.

With programs like Silent-Talk in place, we cannot be sure that the future of BCI technology will be benign. However, some people see this progression towards greater and greater technological capability, even technology that may interfere with normal human behavior, as inevitable and even natural, welcoming it with open arms. In the words of Kevin Warwick, a pioneer in neurorobotics on his self-titled website:

“The step to Cyborgs offers humans a natural, technological upgrade in the technological world we have instigated. I believe we will, via technology, be able, in the future, to detect all sorts of signals that presently we cannot. This will, I feel, change the way we not only sense but also understand the world around us. I feel it will be the next evolutionary step.”

Warwick’s whole-hearted acceptance of cyborgs is not only theoretical either. He considers himself one of the first human cyborgs, having undergone two different surgical procedures that blurred the human-machine divide. The first surgery implanted a microchip under his skin that allows him to turn on lights and open the doors of his laboratory without lifting a finger. During his second operation, a BCI was surgically implanted into the nerves of his left wrist and attached to wires that came out of his elbow. This BCI allows Warwick to send and receive signals through his peripheral nervous system. He has used this BCI to receive ultrasonic input from the environment around him (which humans cannot normally detect), and even receive neural input from his wife, who agreed to briefly fuse her nervous system with his. When his wife clenched her fist, Warwick received a “pulse” in his brain.

This experiment demonstrates how a simple BCI capable of relaying just a blip of electricity can be turned into Morse code to receive complicated information. The information received could be anything from changes in the stock market, to answers on a test. Like all forms of technology, BCIs will continue to improve, allowing for more precise signal communication as time goes on. For this reason it seems as though, however far in the future, there may come a time when BCI implants are an advantage, and the pressure to “keep up” will cause a cyborg-sweep in the human population. When asked about this possibility on his website, Warwick said, “Those who want to stay human can, and those who want to evolve into something much more powerful with greater capabilities can. There is no way I want to stay a mere human.”

Jerry Tullo Neurorobotics and the Dawn of the Cyborg-Era

Spotlight: Famous Cyborgs in Fiction

While neurorobotics as therapy is still a developing field, the concept of cyborgs has captured the imagination of directors and authors for decades. Here are some famous cyborgs that have made their way onto the silver screen:

Dr. Octopus (Spider-man): Brilliant but mad Dr. Otto Octavius supplemented his body with six mechanical tentacles to aid him in his nuclear experiments—but after a freak lab accident, Octavius became a criminal. When not wearing the tentacles, Dr. Octopus is still technically a cyborg since he is severely near-sighted and has to wear glasses.

Darth Vader (Star Wars): Perhaps the most famous cyborg of all, Anakin Skywalker’s crippled body is kept alive by an advanced suit of armor which enables him to breathe, see, and (of course) fight with a lightsaber.

Neo (The Matrix): In the stark real world, Neo’s body is outfitted with various plugs and sockets for nutritional intake. Most impressively, and most reminiscent of Dr. Warwick’s experiments, Neo’s neck contains a direct input/output into his brain, allowing him to enter the virtual world that we all (apparently) live in.

Inspector Gadget: While the likes of Darth Vader and Neo might conceivably become a reality, we will likely never see a cyborg likes Inspector Gadget. With fantastic powers such as the ability to launch helicopter blades from his head (“Go Go Gadget Copter”) and to extend his legs (“Go Go Gadget Legs”), Inspector Gadget would likely be an unstoppable force in reality.
What is fear, and is it a good thing? In most cases, fear is a natural, healthy evolutionary tool that tells us to avoid dangerous situations. Fear of a hungry tiger is immediate and gripping, but once we have safely run away, the fear evaporates. Sometimes, however, when people are confronted with traumatizing memories, fear can become overwhelming, persistent, and pathological. Though fear is not fully understood, we at least recognize that when we shift our focus from typical fear—an adaptive psychological phenomenon—to pathological fear, we must confront a spate of different underlying mechanisms and devise new ways to ameliorate such fear. But the challenge is daunting: how do you deal with fear when it transitions from a state of mind to a state of being?

Post-traumatic stress disorder (PTSD) is characterized by a traumatic, recurring fear attached to and triggered by particular memories. Over time, the memory becomes inseparable from a feeling of fear. The fear involved in PTSD is not only the instinct that one should fear something, but a fear long since consolidated into a memory, such as a specific battle during a war. Although the event has passed, whenever something triggers the memory of the event, fear floods back as well. The Diagnostic and Statistical Manual, revised fourth edition (DSM-IV-TR) states the diagnostic criteria for PTSD as a persistence recurrence of memories of a traumatic event, avoidance of such an event, and psychological arousal in response to a memory or version of the event that persists longer than one month. In other words, PTSD is fear gone awry.

How does fear, in general, manifest in the brain? The “fear pathway” in the brain overlaps to some degree with the “memory pathway.” The amygdala, two almond-shaped nuclei deep in the brain, is involved in both memory and fear. The fear response starts in the lateral amygdala, then goes to the hypothalamus and elicits a physiological response. “Fear neurons” also project to the prefrontal cortex, the center for planning and decision-making (Pankaj & Frederick, 2008). However, the exact neurological mechanisms by which memory and fear become entangled are unclear.

In treating PTSD, clinicians must deal with both the memory and its attendant fear and teach their clients how to weaken the connection when they become pathologically entwined. Cognitive-behavioral therapy (CBT) is the most common form of treatment for PTSD. In talk therapy sessions, patients are encouraged to draw out the traumatic memory in order to change the patients’ perceptions of the memory, as well as alter the avoidant behaviors that reinforce the idea that the memory should be shunned at all costs. Brendan Depue and his colleagues at the University of Colorado argue that cognitive restructuring has been vastly helpful because it attaches a new emotional significance to a memory (Depue et al., 2007).

The prefrontal cortex has been specifically implicated in conditioning-based fear learning and the extinction of fear (Pankaj & Frederick, 2008). The prefrontal cortex is also involved in inhibition and social awareness. Common to all of these functions is the prefrontal cortex’s unique role in helping us plan ahead, discipline our immediate reactions, and assess consequences. In fact, neuroimaging studies of a specific area of the prefrontal cortex and amygdala suggests a model of PTSD with two key elements: 1) the emotional distress characterizing PTSD arises from hyperactivity in the amygdala, and 2) this hyperactivity is caused by decreased activity in the...
prefrontal cortex (Koenigs & Grafman, 2009). Putting it all together, PTSD seems to be the result of the prefrontal cortex failing to properly inhibit signals from the amygdala, causing the amygdala’s activity to become hyperactive. First of all, this implies that the fear is not merely residual but actually returns in full force whenever the memory is recalled. This is seen often in victims such as war veterans, whose reality is suddenly eclipsed by the trauma of recalling a painful memory. Second, it shows that if we can somehow regulate the activity in the amygdala directly, we can keep it from setting off alarm signals whenever the prefrontal cortex fails to intervene. Depue and his colleagues posit that cognitive restructuring decreases activity in the amygdala via a pathway from the prefrontal cortex to the basolateral amygdala (where fear begins to be consolidated). This way, it can lessen the physiological arousal accompanying fear memory recall in PTSD, and thereby allow psychologists to re-attach a more positive emotional significance to a negative memory (Depue et al., 2007). Although CBT appears to be an effective therapy for PTSD, some critics of CBT, such as Emily Holmes, a psychiatrist at Oxford University, argue that while suppression of the emotional coloring of memories in CBT may reduce distress in the short term, it only exacerbates traumatic memories in the long term (Holmes et al., 2007). CBT can only suppress the fear associated with a memory, but if a treatment could stop a patient from accessing a certain memory or stop it from recurring, the benefit could be more permanent. Therefore, for patients who do not respond to attempts to change the emotional coloring of their traumatic memories, erasing the memory itself may be the best course of action. Fear erasure is one field that has grown considerably in the past two or three years. Research is converging upon the possibility of physically erasing the fearful component of a fear memory. Of course, it is not as simple a matter as tracking the memory down and zapping it. There is no quick medical or psychological fix to forgetting a trauma, as the phenomenon is complex and several brain regions and circuits are involved.

There have been several successful attempts to make memories themselves extinct. Jin-Hee Han et al., in March 2009, deleted several neurons in the rat amygdala that were part of the “memory trace,” which consolidates a fear memory. Previous studies had shown that only neurons exhibiting a specific, very high level of a certain protein (CREB) were part of the memory trace, and Han et al. found that deleting just those neurons interrupted the expression of an already established fear memory. In an earlier 2007 study, Sophie Tronel and Cristina Alberini deactivated certain receptors in the amygdala that disrupted a traumatic memory via the memory trace (Tronel & Albertini, 2007). While an invasive drug treatment effective in rats may not immediately be generalizable to humans, the possibility of identifying certain neurons that are part of a memory trace and can be disrupted to delete a fear memory is still a significant step in finding a treatment for humans. A study conducted in July 2009 found that persistent fear memories characteristic of PTSD are rapidly forgotten if they are formed without the basolateral amygdala (BLA) intact. Without the BLA, a fear memory cannot be retained for very long. Additionally, even if other brain structures support new learning in its place, no permanent fear memory storage is possible without the BLA (Poulos et al., 2009). Another option for erasing a fear memory is to re-code it so that the memory is redirected towards a new, positive association. It is similar to “restructuring” because it involves changing the old fearful memory’s emotional associations. This idea of learning a harmless association in place of a fearful one is the basis of a study conducted by Marie Monfils and her colleagues. Using behavioral conditioning, they first created a fear memory in rats by pairing a neutral stimulus with an aversive condition. They then re-paired the stimulus with a non-threatening condition to eliminate the memory’s negative emotional association. Attaching a positive or neutral emotional significance to this new memory detaches the memory from the fear (Monfils, 2009).

Despite the scientific advances made by these studies, we are still far from having the erasure of traumatic fear be an in-and-out surgery. PTSD is a complicated psychological disorder, and the human amygdala is different from a rat’s. Monfils’ work on rats may not translate perfectly in humans, especially since permanently deleting neurons affects brain function adversely. Given that there are some consolidated emotional memories that are vital to human survival, surgeries such as those to remove the basolateral amygdala could have long-lasting negative consequences. Work that has been done in the field of memory erasure has made tremendous progress in recent years. Han et al.’s discoveries in changing the function of neurons specific to a memory trace could especially be vital to future experimentation in fear erasure. When fear is pathological, we must find ways to treat it without using drastic methods that undermine our useful, normal fear circuitry. For now, cognitive restructuring and CBT already work for up to 70% of victims. Scientists are on their way to finding a cure for the others.

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“Tell me one last thing,” said Harry. “Is this real? Or had this been happening inside my head?” To this question, Dumbledore replies: “Of course it’s happening inside your head, Harry, but why on earth should that mean that it is not real?” Indeed, near the end of J. K. Rowling’s famous literary saga, Harry Potter, apparently dead, feels as if he has floated into the familiar train station where, each September, he would cross the threshold between the mundane and the magical. Completely lucid despite his ethereal surroundings, Harry stumbles upon his former headmaster Albus Dumbledore—also dead—and the two have the above exchange. After their conversation, Harry makes the choice to return to a state of consciousness, oozing back into his body and resuming the life he momentarily left.

Both fans and critics of Harry Potter will concede that this magical story gains much of its popularity from the commonalities it shares with our real, “Muggle,” world. Survivors of near-death experiences (NDEs), such as Laura Geraghty, might argue that Harry’s out-of-body sensation is one such commonality. After falling into full cardiac arrest without blood pressure, pulse, oxygen, or blood flow, Geraghty felt as if she, like Harry, had entered an extra-corporeal state. As she described, “My body was here, and I just floated away. I looked back at it once, and it was there.” Furthermore, Geraghty too experienced the life-like presence of deceased loved ones—in place of Dumbledore, she saw her mother and ex-husband.

Geraghty was shocked 21 times before she was revived, and she awoke convinced that she had truly gone “someplace else other than here… someplace that not everybody can go”. Geraghty and other survivors of near-death experiences, which occur at a rate of almost 800 per day in the United States according to the Near Death Experience Research Foundation, are left with the same fundamental question as Harry: are these experiences “real”? While scientists have been unable to deliver as forthright a response as Dumbledore, research has offered various physiological and psychological explanations for such experiences and the sensations that accompany them.

Psychologist, writer, and NDE survivor Dr. Susan Blackmore ventured one such explanation in a 1996 issue of the Journal of the Royal Society of Medicine. According to Blackmore, NDEs may be induced in part by the mere expectation of death, explaining why such experiences often occur to people who believe they are dying when, in actuality, no mortal clinical emergency exists. Such an “expectation of death” theory also explains why religious background may influence the details of the near death experience. For example, while Christian survivors often report having seen Jesus, Hindu survivors have described seeing envoys of the deity Yama, the Hindu lord of death, coming to collect them.

Yet, as Blackmore concedes, the substantial similarities among accounts of NDEs across ages and cultures indicate that religious expectations cannot explain these occurrences entirely; she goes on to point out the potential physiological role of endorphins in occasioning these experiences. Endorphins, peptide hormones found chiefly in the brain, bind to the brain’s opiate receptors under stress-ful situations such as physical trauma and intense fear. Endorphins typically raise the brain’s pain threshold and produce sensations of well-being, acceptance, and at times euphoric pleasure, perhaps indicating a causal connection with the positive emotional tone of the majority of NDEs.
Some research has supported Blackmore’s theory that endorphins are implicated in NDEs. For example, in a 1983 study done by I.R. Judson and E. Wiltshaw, a 72-year-old cancer patient experiencing a pleasant NDE reported feeling horror and misery after being administered naloxone, a morphine antagonist that can block the effects of endorphins. Nevertheless, the extent to which endorphins may be the physiological cause of NDEs remains unclear. Neuroscientist Melvin Morse has suggested that the neurotransmitter serotonin, which is involved in regulating perception of pain, the sleep-wake cycle, and mood in humans, could be more importantly involved in NDEs (Blackmore, 1996).

More recent investigation by Dr. Rick Strassman of the University of Mexico has suggested that N,N-dimethyltryptamine (DMT), a potent psychedelic that he hypothesizes to be naturally produced in the pineal gland, in addition to—or instead—play a role in these phenomena (Strassman, 2009).

Blackmore also considers anoxia, or unnaturally low oxygen levels in the body’s tissues, as a potential explanation for aspects of typical NDEs. Oxygen depletion in non-life-threatening situations, such as during the gravity-induced loss of consciousness that sometimes occurs in pilot training, has been reported to produce visions and out-of-body experiences. Oxygen depletion in non-life-threatening situations, such as during the gravity-induced loss of consciousness that sometimes occurs in pilot training, has been reported to produce visions and out-of-body experiences similar to those characteristic of NDEs. With particular regard to the “tunnel and light” sensation often described by NDE survivors, Blackmore theorizes: “Since the visual cortex is organized with many cells devoted to the center of the visual field, and few to the periphery, random excitation will produce the effect of a bright light in the center fading out towards darkness, in other words, a tunnel effect.”

The implications of anoxia were probed in a recent George Washington University study of the levels of consciousness of terminally ill patients. According to Irene Klotz in an October 6, 2009 DiscoveryNews article, doctors noted that moments before death, patients experienced bursts of brain activity that were comparable in both their intensity and duration. The doctors speculate that the identical surges in activity are caused by discharging of the brain’s neurons as they lose oxygen and, furthermore, that the same oxygen depletion could trigger the imprinting of vivid memories in the minds of near-death survivors, inducing an out-of-body experience. Still, the fact that different forms and rates of anoxia have affected patients differently complicates the consideration of anoxia in NDEs. For example, the confusion often occasioned by anoxia stands in stark contrast with the lucidity typically associated with NDEs.

While Blackmore attempts to deconstruct the NDE into representative components in order to explore multiple potential causes, others, such as University of Kentucky neurologist Kevin Nelson, have offered more holistic interpretations of the phenomena. According to Nelson, such experiences induce a “fight or flight” reflexive switch into an REM, or rapid eye movement, state of consciousness. Such a state naturally occurs during an individual’s sleep cycle, typically about 90 minutes after sleep onset. During this REM stage, respiration and heart rate quicken and become more irregular, the eyes swiftly move in different directions, and the main voluntary muscle groups become immobile. Significantly, REM sleep is also characterized by brainwave patterns similar to those during consciousness, resulting in increased brain activity and, in turn, intense dreaming (Sonne, 2009).
Skepticism of such neurological and physiological theories abounds, as some people—many of whom are NDE survivors themselves—are not ready to accept that such experiences reside solely in the brain rather than in a more abstract or divine realm. Yet, notably, research into NDEs is increasingly—and ironically—validating the testimonies of these survivors by suggesting that such phenomena, while not actually extrasensory, are not simply imagined either. Rather, they can both exist and be rationally explained. Perhaps further investigation of NDEs will converge on the shrewd opinion of Albus Dumbledore—that the experiences of our mind are attended by the most profound reality.

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If you have ever been grilled in the interview seat, made an important sales pitch, or popped the marriage question, chances are you’ve wished you could know what was going on in the other person’s head. Sadly, mind reading continues to elude scientists, and there remains no way to ascertain the nature of another person’s private mental processes before he or she reveals them. However, new research indicates that while you may not be able to divine exactly what others have decided, a look into their eyes can tell you when they have made up their minds.

In a study at the Philipps-Universität Marburg in Germany, Professor Wolfgang Einhäuser-Treyer and his team observed 20 subjects perform three simple decision-making exercises. These included an “immediate overt response” task, in which the participants were instructed to press a button when they saw a blue dot turn red on a screen, a “covert digit choice” task, in which they secretly selected a number from a successive display of digits and revealed their selection later, and a third task in which the subjects did not select a number but instead indicated which of five displayed numbers on a screen was underlined. For the first two tasks, participants were told they could receive a small financial reward for pressing the button during a “lucky” second or choosing a “lucky” number.

Using an infrared eye-tracking tool that continuously measured the diameter of each subject’s left pupil while he or she performed a task, the researchers found that the timing of maximum pupil dilation corresponded closely with the time at which the participant made a decision, and not the time at which the decision was reported. Furthermore, during the second task, Einhäuser-Treyer and his team were able to predict what digit a subject had chosen by comparing pupil diameter during each two-second interval at which each digit was shown.

What causes this link between the eyes and the mind? The neurotransmitter involved in pupil dilation, noradrenaline (norepinephrine), is related to arousal levels, so one may venture that the anticipation of financial reward occasioned the subjects’ increased pupil dilation. However, the results found in task three, which did not involve the promise of reward, suggests instead that noradrenaline might be involved in the rapid consolidation of behavioral decisions. Whatever the reason for this potential physiological clue to decision-making, be sure to pocket a pair of shades next time you want to keep your decisions to yourself.

REFERENCE:

Writing Memories with Light

By Hanna Retallack

With a flash of light, the Men in Black can erase your memories of secret weapons laboratories and alien creatures. In real life, powerful lasers are used all the time to destroy cancer cells and can wipe out memories if they damage enough of the brain. The more delicate task, however, is to use light to create memory. Imagine light, shining through a small optic fiber inserted into a fly’s brain, actually causing the fly to remember a bad odor. This light can also be used to make neural circuitry visible in real time or restore breathing in paralyzed animals. All three feats are possible with optogenetics, a new field that mixes genetic engineering with neuroscience.

The Basis of Optogenetics

The complexity of the brain’s connections is comparable to that of a creative spider’s web. Imagine a spider that spins patterned segments and reweaves them in chunks. Now mentally fold that web into a ball and try to trace a single strand. You begin to see that it’s hard enough to trace the output of a small group of localized neurons, let alone find and stimulate a targeted population of cells dispersed throughout the brain.

The old standard for stimulating or recording from neurons is implanting an electrode very near the neurons of interest. This technique is widely used, but it has its limitations, as the electrical shock created by the electrode is very different from the one naturally generated by the brain. In addition, it is nearly impossible to target just one subtype of neuron. Enter optogenetics.

Recently, scientists have begun to replace this old electrode technique with light-activated systems. Through genetic manipulation, the cells of interest are artificially endowed with light-sensitive proteins or a “caged molecule” system, so that researchers can control neuron firing (the electrical signal that carries information from one cell to another in its frequency and amplitude) by shining light on the cells. The temporal and spatial precision of this technique are its most attractive features, as only the genetically modified cells will fire. Light-activated neurons are now an essential tool for investigating the circuitry of disease, memory, and behavior.

Naturally Photosensitive Proteins

The goal of many optogenetic studies is to recreate the electrical signals of a single neuron population in a controlled manner. A popular tool is the photosensitive protein Channelrhodopsin-2 (ChR-2), an ion channel protein from the algae Chlamydomonas (Kramer et al., 2009). The great advantage of ChR-2 over electrodes is the precision with which it responds to light. When introduced into neurons via some sort of transfection or viral transduction technique, ChR-2 can precisely turn the neuron “on” and “off.” With controlled flashes of light, a subpopulation of neurons can be forced to fire in a precisely defined pattern of frequency and amplitude. Compared with electrode stimulation, ChR-2 activation is like controlling the arm of a drummer to adjust the volume and speed of his beats instead of shouting “stop” and “go.”

Tsai et al. (2009) found ChR-2 useful for mimicking the firing of dopamine-producing neurons, which are responsible for producing a particular electrical wave pattern in mice brains.
Here Come the Men in Black: Writing Memories with Light

. With light as an on-off switch, the researchers gained a precise control over the oscillation of brainwaves that could not have been achieved with clumsy electrodes.

**Restoring Breathing after Spinal Cord Injury**

Although ChR-2 can act as a sudden on-off switch, it can also affect changes in neural circuits that are retained even after the initial impression. In mice whose breathing circuitry was damaged with a spinal cord injury, ChR-2 activation of motor neurons was sufficient to cause the diaphragm muscles to contract and to maintain a breathing pattern hours after the light treatment (Arenkiel & Peca, 2009). Essentially, the neurons were forced to retain memories of how to coordinate breathing.

**The Caged Molecule System**

A related optogenetic method uses a small molecule that is biologically inactive until exposed to light. Of particular convenience are modified neurotransmitters that lose a protecting group (are “uncaged”) when illuminated. Molecules such as ATP can also be modified to create a conditional lock-and-key system where only the uncaged form interacts with a downstream molecule. Using caged ATP, Claridge-Chang et al (2009) made a significant breakthrough in unlocking the mystery of odor preference in flies, revealing the mechanisms for conditioning and implanting memory.

One group of flies received a small electrical shock when exposed to a particular odor. Another group received light pulses with the odor, which activated the photosensitive ATP system in dopamine-producing neurons.

Amazingly, both groups of flies learned to avoid the odor. Thanks to the tight control over the timing of neuron firing during conditioning, the researchers also pinpointed the 12 neurons that were necessary for transcribing the immediate feeling of “Oof, something feels bad, and wow, what a strong smell,” into a conditioned memory, such as “I know that smell, bad things are about to happen.”

**The “Optical Implantation of Memory”**

As the heading from the Claridge-Chang experiment suggests, their work with flies and caged ATP points to a bright future in our understanding of memory creation and retrieval. The most exciting part is that their experiment demonstrates how we can optically generate thought, tuning the brain with light.

Here’s why it’s so incredible. Destroying memories is relatively easy because memory, like any other brain function, is patterns of electrical impulses.

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Here’s why it’s so incredible. Destroying memories is relatively easy because memory, like any other brain function, is patterns of electrical impulses. The impulses happen to be a consequence of neuron shape and connections that change when you learn and recall a memory, but you can disrupt the thought by disrupting the electricity without affecting other brain function, we are looking for a technique to stimulate and observe the impulses with extreme spatial and temporal precision. Optogenetics delivers.

The future in optogenetic technology promises a wider variety of photosensitive channels and caged molecules, and more sensitive illumination techniques. A generation ago, imagining neuroscience research that combined photochemical and genetic approaches would have been science fiction. Today researchers are using optogenetics as a remote control for behavior, to write a memory in an animal’s brain, and to probe the circuits involved in neurological disease. It allows us to follow the chain reactions when we flip a switch in the brain, and, more importantly, it allows us to flip that switch with incredible precision in location and timing. Though we are still a far cry from the Men in Black, optogenetics is sure to be a part of our reality in the future.

**References:**


Is Genius Born or Made?

The Development of Genius

By: Nisha Deolalikar and Sarah Zhang

The question of genius harkens back to the age-old debate of nature versus nurture: is a genius someone who simply possesses unattainable heights of innate intelligence? Or, less deterministically, do we all have some element of undiscovered genius within us? Perhaps genius is a matter of capitalizing on a latent ability rather something we are born with or without.

The confusion surrounding the precise definition of a genius arises from multiple perceptions of what constitutes “intelligence”. To some, a genius may be someone with a quick and agile mind, an uncanny ability to recall facts, and an ability to emit an aura of intelligence. To others, a genius must have redeeming qualities beyond the simple scope of memorization; original insight is a necessity to propel someone from the merely “intelligent” category to the level of a true genius. In The Critique of Judgment, Immanuel Kant notes that “originality is the essential character of genius.” Kant’s emphasis on originality in this context suggests a belief in inborn genius, rather than genius acquired through tedious work undertaken over time.

In his bestselling book Outliers, Malcolm Gladwell takes the other view, equating world-class, “genius” levels of expertise with a 10,000 hour rule, suggesting that nearly anyone can develop the skills and achievements of a genius with a time investment of 10,000 hours in a single activity. Although the 10,000 hour rule has been met with an appropriate amount of skepticism, its foundational principle is solid: hard work pays off. Gladwell firmly believes in the practice of developing genius rather than tapping into “giftedness” – as such, he refutes the conventional connection between child precocity and genius. According to Outliers, child precocity is merely the result of amassing many hours dedicated to one particular task at an early age; however, comparably long hours can theoretically be accumulated beginning at any age.

Gladwell’s theory, which emphasizes hard work over innate talent or childhood brilliance, offers hope for anyone: it is never too late to transform oneself. All that is required is a tremendous time commitment; 10,000 hours spread over 10 years requires 20 hours of practice a week - or approximately 3 hours every day. The fact of the matter is simply that few people are willing to dedicate such a regular block of time to one activity for years on end. However, those who do so are duly rewarded.

In contrast to Gladwell’s claims, there is a longstanding “scientific” view of creativity as an innate ability. One early enthusiast for this view is Francis Galton, cousin to Charles Darwin. Galton applied the importance of heredity in his cousin’s theory of evolution to his own study of genius. Our general contemporary view of genius is not as deterministic. If the existence of gifted and talented children programs is any indication, there is a general belief that genius, though innate, needs to be nurtured. In his book Genius 101: Creators, Leader, and Prodigies, University of California psychology professor Dean Keith Simonton argues that...
Gladwell’s “drudge theory” cannot fully account for genius. There are personality and character traits, at least partially inherited, which make it possible for one to commit 10,000 hours to practice and learn from the practice. “Without adequate zeal how can you have sufficient “capacity for hard labor?” asks Simonton, “…You will only become a genius if your genetic makeup lightens the labor so you never let up.”

Historical figures such as Wolfgang Amadeus Mozart and Pablo Picasso tend to ignite even more debate surrounding the definition of the word “genius,” as such examples don’t universally support either nature or nurture. For example, young Mozart, though undoubtedly precocious and talented at an early age, only reached his peak of proficiency at a much later age – after committing perhaps thousands of hours toward his task of musical composition. Pablo Picasso also began painting at an early age, but achieved his greatest prowess much later on in life. To the contrary, Paul Cezanne, another famous painter, was a late bloomer: he began painting far later than his contemporaries, but reached a level of success that the majority of them could not realistically hope to ever attain.

The popularity of Gladwell’s book and the 10,000 hour rule may well lay in the reassurance it provides for us all. It presents a ray of hope to all the “late bloomers” who wish to tap into their inner reservoirs of ability only at later stages in life. It may be late to become the next Mozart, but with enough practice, there is always the chance that you can become the next Cezanne.

Drugs like Adderall or Ritalin were originally intended to help people with Attention Deficit Hyperactive Disorder (ADHD) by increasing alertness and decreasing fatigue. However, they also have a seemingly miraculous effect on people without ADHD by conferring the ability to study all night without feeling tired and greatly increasing productivity. Have a 15-page paper due the next day? A midterm you haven’t started studying for? No problem – simply pop an Adderall, and it’s guaranteed that your paper will have practically written itself in a quarter of the time you usually spend on it.

With effects like these, it’s no wonder that Adderall has been termed the miracle drug. A study by Alan De-Santis at the University of Kentucky found that 34% of sampled undergraduates at a large, public, southeastern research university in the United States had abused ADHD stimulants for the purposes of studying. While on Adderall, students reported being able to memorize much larger amounts of information and study for extended periods of time without losing focus, all while needing far fewer hours of sleep. However, this begs the question: if genius is only a matter of putting in 10,000 hours into a particular subject, then could Adderall make geniuses of us all? And where do we draw the line between the increased focus and alertness that Adderall gives us, and the effects of a cup of coffee or a can of Red Bull? While Adderall helps its users and abusers focus, it doesn’t always help them focus on the right things. Those who use Adderall off-label have reported hours spent obsessively painting fingernails or rearranging desks. The long term effects of Adderall use on the brain function are also unestablished. Genies may come in bottles, but genius seems unlikely to come from bottles of pills.
Take a lesson from Icarus: don’t fly too high with fake wings. Red Bull’s ads boast that “It gives you wings,” but next time you find yourself tempted to grab a can of Red Bull, you might first want to consider its effects, including its potentially dangerous side-effects. The chemicals in Red Bull induce the mental stimulation sought-after by college students and workaholics all over the nation, but if you must sip instead of sleep, beware of the potential damages the energy drink could cause.

Red Bull first hit U.S. markets in 1997. Since its launch, it has become one of the most popular energy drinks among young Americans. Inspired by an energy drink from Thailand, Red Bull has accrued a large market that has exponentially increased since founders Dietrich Mateschitz and Chaleo Yoovidhya released the product. Red Bull is not the only energy drink presently available in the U.S.; others, like Monster, Full Throttle, Jolt, and the 5 Hour Energy Drink, are gaining popularity, especially on college campuses where wearied and stressed students search for stimulants to counteract the need for sleep.

What exactly is in this can that will “give you wings”? Like coffee, Red Bull contains caffeine—specifically, 80 mg of it, which does not seem like much compared to the average 140 mg of caffeine in a Starbucks vanilla latte. For further comparison, a 16 oz. cup of Dunkin Donuts brewed coffee has about 143 to 206 mg of caffeine, while a can of Coca-Cola contains about 35 mg. Caffeine functions by inducing brain waves comparable to those present when you are awake and focused, an observation which likely accounts for its effect of “wakefulness.” It does this by modifying the way in which naturally-occurring neurotransmitters function, especially in the hippocampus, a brain region involved in mood regulation and memory formation (Fredholm et al. 1999).

80 mg of caffeine intake by itself is unlikely to have many adverse consequences, but Red Bull is often consumed rapidly and in great numbers, thereby elevating the health concern associated with caffeine. “Caffeine intoxication” is a recognized clinical syndrome included in the DSM-IV (a manual of psychiatric disorders used by all psychiatrists in the United States), which is marked by nervousness, anxiety, insomnia, stomach upset, tremors, rapid heartbeat and, sometimes death.

Although Red Bull contains a little less caffeine than the average cup of coffee, most users would attest to a more intense wakefulness and ability to focus experienced with Red Bull. Much of that intense wakefulness is due to its host of other ingredients, including sugar, B-vitamins, ginseng, guarana, and taurine. These chemicals also comprise the bulk of the health risk potentially posed by Red Bull.

Taurine, which crosses the blood-brain barrier and stimulates the brain in a way similar to caffeine, has been used as a supplement for epileptics and those with uncontrollable facial twitches. While a 2008 review of the scientific literature on taurine found no compelling evidence to suggest that it poses serious health risks (Clauson et al., 2008), other experts suggest that taurine has many adverse effects. To begin with, Red Bull contains 1000 mg of taurine—over ten times the daily intake of a person on a regular diet. Some experts and studies have suggested that such high levels of taurine consumption can be linked to heart disease and seizures. Additionally, research suggests that taurine actually induces sleepiness, an observation that may account for the hard “crash” often felt hours after drinking Red Bull (Haas, 2006). There is still considerable debate regarding the health risks posed by taurine alone.

The possible health consequences of Red Bull don’t end with caffeine and taurine though. Red Bull contains a host of other chemicals with similarly debated health risks. Ephedrine is an appetite suppressant, concentration aid, and decongestant. Ephedrine is similar to amphetamines and inherits some of the adverse effects associated with those chemicals, including various cardiovascular detriments and, possibly, dependence. Guarana, a seed that contains more caffeine than the coffee bean, can lead to...
seizures in some people when combined with additional caffeine from an energy drink (Iyadurai and Chung, 2007). Perhaps most importantly, some studies have suggested that guarana and ephedrine interact to cause potentially fatal cardiac arrhythmia (Drugs.com, 2004).

Even the more “benign” ingredients of Red Bull can have adverse effects. Ginseng, for instance, usually has a positive connotation as a memory aid, but it can also cause allergic reactions in some individuals. Moreover, it can lead to nervousness and insomnia (Harmon, 2002). Red Bull also contains large amounts of vitamin B12, which is responsible for the body’s metabolism. The over consumption of vitamin B12 can lead to anxiety and panic attacks, heart palpitations, chest pain and insomnia (Frady, 2009).

The health risks posed by all of the aforementioned chemicals increases as dosage increases—a crucial fact considering that the body builds up tolerance to caffeine, guarana, and taurine. Thus, one is driven to drink Red Bull more frequently and in greater quantities to regain the original level of focus and wakefulness. Moreover, partly due to the body’s difficulty in metabolizing leftover caffeine, periods of such wakefulness are punctuated by “crashes”—that is, periods of exhaustion (Dunkin, 2009).

So what’s the answer to your sleep deprived life? Given the spate of potential health risks associated with Red Bull, the answer is probably what you suspected all along: a schedule that leaves room for sleep. Sleep keeps your heart healthy, may prevent cancer, reduces stress and inflammation, helps the body repair itself, consolidates memories, and might help you lose weight and be less depressed (Stibich 2009). So next time you’re tempted to don some of Red Bull’s wings, you might elect to lie down for a power nap instead.

We polled a sampling of Harvard students on their energy drink habits.

Some testimonials from your classmates:

- “They get me through the day every day of the week. I honestly don’t know what I’d do without them.”
- “Towards the end of the fall semester, I could drink a Monster and fall asleep within 30 minutes... it was bad.”
- “One time we had cases upon cases of free energy drinks from Monster. Those were the glory days.”
- “Rockstar is the reason I have a thesis and not a blank Word document (in addition to a term paper for a fall term class and a non-failing grade on several exams). Quite simply, it is the only thing that will keep you awake and which is actually pretty okay tasting.”

References


“To feel envy is human, to savor Schadenfreude is devilish,” proclaimed German philosopher Arthur Schopenhauer. Derived from the German words Schaden, meaning “damage,” and Freude, meaning “joy”, schadenfreude is the feeling of pleasure gained from seeing the misfortune of others. In an age when it is possible to find thousands of websites dedicated to laughing at the failure of others, there is clearly a widespread interest in schadenfreude. After all, why else would sites such as failblog.com and fmylife.com garner 4.5 million and one million hits per day, respectively? It seems that our culture loves learning about the misfortunes of others, despite the irksome feeling that there may be something sinful in this pleasure.

As we log in to laugh out loud at the videos of escalator falls, sports mistakes, and ignorant political remarks, are we in fact being as malicious as Schopenhauer suggests? Psychologist Dr. Aaron Ben-Ze’ev of the University of Haifa in Israel suggests that Schopenhauer may have been too critical. In fact, Ben-Ze’ev thinks schadenfreude is rather benign, and he identifies three components of schadenfreude that mitigate its apparent cruelty. In all of the cases of schadenfreude experienced by users who log into these sites, the observed is usually perceived as deserving the bad fortune, the misfortune is minor, and the observer has no part in actively generating the misfortune (Ben-Ze’ev, 2009). Understood in this context, schadenfreude is relatively harmless – more mischievous than devilish.

In Ben-Ze’ev’s first point, schadenfreude differs from base cruelty because we feel the person might have deserved the misfortune. This puts us in a position of observing a just punishment and allows enjoying another’s pain to seem morally acceptable. Secondly, the misfortune must be minor so that we are not moved to pity. While it may be funny for your annoying neighbors across the hall to lock themselves outside without keys or shoes after a party, it would be difficult to find it humorous if one of them had been hit by a car on the way home. Finally, it must feel as if we are passive spectators who just happen to witness another’s misfortune by chance, or else our schadenfreude would be tainted by malice and guilt. By
contrast, in cases of true sadism, the punishment is neither deserved nor minor, and the observer may even play an active role in causing harm. Given these prerequisites for schadenfreude, ordinary schadenfreude is probably not as evil as Schopenhauer presumes.

Recent research by Dr. Professor Richard H. Smith of the University of Kentucky also suggests that Schopenhauer may have been too quick in his conclusions about schadenfreude. According to Smith, Schopenhauer may have magnified the difference between envy and schadenfreude, when in reality, the two are more interconnected than one might think. In one of his experiments, Smith asked undergraduate subjects to watch videos of two male students describing themselves. In one video, the student boasted of his wealth, high GPA and girlfriend, while in the other, the student spoke of being single and of average wealth and GPA. Predictably, subjects noted that they envied the first student more. When subjects were then told that both students had met with misfortune, they felt more pleasure in learning of the misfortune of the student they envied. This suggests that envy plays a key role in making us feel entitled to schadenfreude.

Why might this be? While envy, or unhappiness at another’s good fortune, may initially seem to be the opposite of schadenfreude, or happiness at another’s bad fortune, Smith suggests that the two are actually rooted in the same motives of human psychology. Smith is interested in social comparison theory and believes that humans appraise themselves primarily by comparing their situations to that of others around them. While the theory

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Why might this be? While envy, or may seem straightforward, it certainly sheds light on many situations, including the prevalence of schadenfreude. When we compare ourselves to someone who is perceived to be in a better situation, we tend to lose confidence in ourselves and experience feelings of dejection and envy. If we are then told that misfortune has befallen that person, our appraisal of ourselves will go up, bringing along feelings of self-worth, happiness, and of course, schadenfreude. Therefore, it appears that the two feelings of envy and schadenfreude are actually intimately connected with each other.

Recent research even suggests that this act, which initially seems so devilish, may be so widespread because it is beneficial to health. Recent research even suggests that this act, which initially seems so devilish, may be so widespread because it is beneficial to health.

References
Rethinking Sadness: New Books

BY JOANNA LI

The current medicalization of grief comes from an oversimplified understanding of Sigmund Freud’s theory of grief, which emphasizes the importance of emotional detachment as the resolution of grief. Although some people have complicated experiences with grief, most people show a surprising degree of resilience over time. They find their way through their sadness and pain, rather than allowing it to take over their lives. In Bonanno’s words, grief is “something we are wired for, and it is certainly not meant to overwhelm us,” let alone develop into something persistently crippling or pathological.

According to Bonanno, the origins of this misconception lie in Freud’s early emphasis on the “work of mourning.” Freud believed that those in grief needed to face their suffering and sever ties to the deceased loved one by reviewing every memory and hope associated with the relationship. Apparent mental detachment in the early stages of bereavement could only mean denial or repression. Dr. Bonanno points out that if Freud’s goal was for the bereaved to separate themselves from lost loved ones, he could hardly have prescribed a worse treatment than obsessing over old memories. Nevertheless, Freud’s psychoanalytic descendants adopted the idea that a grieving person had to pass through a series of tasks or stages before healing. Elizabeth Kübler-Ross’s five stages of grief, actually derived from observations of patients dealing with their own imminent deaths, fit neatly into this model, and the necessity of doing the “work of mourning” became widely accepted.

According to these theories, apparent resilience in the face of grief is a sign of a blocked process, a hidden pathology. Julia Martinez, one of Bonanno’s patients, tried to keep her mind on her studies and friends at college after her father’s death. Although she grieved, she focused on comforting her mother and brother, and six months later, she was moving on with her life and looking forward to a summer internship at a local newspaper. Her mother, disturbed, referred her to a grief counselor, wondering if Julia was in denial. Her therapist tried to delve into the nature of her relationship with her father, but there was nothing to be found. Julia had loved her father, beyond a doubt, and felt patronized by the insistence that there must be something wrong with her.

In Dr. Bonanno’s experience, this sort of reaction, so frequently misunderstood, is the norm for most bereaved people. It is true that some people’s grief reactions become complex and tormented, and that those people may

The Other Side of Sadness: What the New Science of Bereavement Tells Us About Life After Loss

GEORGE A. BONANNO

A sked to imagine a person in grief, we’re likely to picture someone devastated, wracked with suffering and constantly on the verge of tears. The Diagnostic and Statistical Manual of Mental Disorders (DSM) considers the symptoms of bereavement to be identical to those of major depression. We know, more or less, how a grieving person should feel and behave, as he or she makes the hard journey through the Kübler-Ross model of the five stages of grief: denial, anger, bargaining, depression, and acceptance.

Dr. George A. Bonanno, Chair of the Department of Counseling and Clinical Psychology at Columbia University, doesn’t think the prognosis is so simple or so grim. In The Other Side of Sadness, he describes his experiences interviewing and following hundreds of bereaved people over two decades, from New York City to Nanjing, China. His findings are refreshing and instructive. As many of us might suspect, there is very little evidence for the “five stages of grief,” and the grieving process varies across cultures and individuals. Not everyone who fails to grieve in the expected ways needs therapy. The current medicalization of grief comes from an oversimplified understanding of Sigmund Freud’s theory of grief, which emphasizes the importance of emotional detachment as the resolution of grief. Although some people have complicated experiences with grief, most people show a surprising degree of resilience over time. They find their way through their sadness and pain, rather than allowing it to take over their lives. In Bonanno’s words, grief is “something we are wired for, and it is certainly not meant to overwhelm us,” let alone develop into something persistently crippling or pathological.

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For all appearances and purposes, antidepressants are extremely successful. The pharmaceutical industry has built a $19 billion market around these so-called “miracle drugs.” “Next generation” antidepressants such as selective serotonin reuptake inhibitors (SSRIs, more commonly known as Prozac or Zoloft) were some of the top selling drugs in 2009, and depression treatment with these drugs has proven highly effective, with industry and clinical studies reporting success rates of more than 80 percent. Into this triumphant climate drops the book The Emperor’s New Drugs: Exploding the Antidepressant Myth by University of Hull Professor of Psychology Irving Kirsch, who states, quite plainly, that “the belief that antidepressants can cure depression chemically is simply wrong.”

Using a statistical technique called meta-analysis that combines the results of multiple related studies, Kirsch examines both published drug findings and Freedom of Information Act-garnered FDA files to present the all-too-plausible theory that there is essentially no positive effect from taking SSRIs. In comparing the efficacy of diverse classes of drugs—SSRIs, tricyclics, barbiturates, benzodiazepines, even thyroid hormone—Kirsch finds them all equally useful, or useless to be more accurate, in treating Major Depressive Disorder (MDD).

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Kirsch identifies a number of sources for the blinders the clinical community has had over its collective eyes. At the level of industry, pharmaceutical companies have distorted the evidence by repeatedly publishing the same trials and selectively publishing positive results. In fact, more than 40 percent of industry-conducted studies never see the light of day. Furthermore, at the level of regulation, even though half of the trials submitted to the FDA show no significant clinical difference between antidepressants and placebos, no action is taken to reevaluate the former’s efficacy, and the FDA consistently refuses to publish such revelations. Kirsch also notes that the FDA receives 40 percent of its funding from fees paid by industry applicants, and some foreign regulatory bodies, such as the British Medicines and Healthcare Products Regulatory Agency, are completely dependent on evaluation fees.

Kirsch also provides an explanation for how SSRIs seem to treat MDD even if their efficacy cannot be explained by the chemical imbalance theory. Kirsch’s theory derives from the reported efficacy of placebos in clinical trials. While placebos accounted for 75 percent of the effect of the “active” SSRIs, patients who received no treatment whatsoever had only 25 percent less success than those who received SSRIs. This means that half of the drugs’ effects were due to placebo effects, and only a quarter due to the “active” molecules in the drugs. To explain this large placebo effect, Kirsch quotes studies in which depressed patients are asked what they found most depressing in their lives. Most responded that their depression itself was the most depressing.

It is “depression about depression”
ment. Anger allows them to vent their frustrations; laughter allows them to “come up for air.” Sometimes people in grief, or those around them, feel astonished, and even guilty, because they cannot believe their own strength and their ability to find comfort, and even joy, in their daily activities. For Bonanno, this is all perfectly normal. He quotes C.S. Lewis, who says “grief is like a bomber circling round and dropping its bombs each time the circle brings it overhead...it is that respite from the trench of sadness that makes grief bearable.” Resilience is a sign of health and courage that defends against pathology.

While travelling and studying bereavement in other cultures, Dr. Bonanno learned that manifestations of grief are culturally determined - not all cultures focus on the emotions of grieving individuals; many emphasize the ceremonies that bring the living together in memory of the dead. In Western societies, for a grieving person to talk about a continued connection with a lost loved one might cause some raised eyebrows and concerned looks. On the other hand, in Mexico, on the Day of the Dead, a woman is perfectly at ease talking at length to her dead relatives and ancestors, offering them food and wine, and asking after the health of saints in heaven. In West Africa, funerals are occasions for drinking, dancing, singing and dirty jokes to “amuse the dead... to moralize a dead person is both indelicate and senseless.” In China, relatives burn joss paper folded into the shapes of objects to be used by the dead in the after-life. These ceremonies can be solemn and lighthearted at the same time. In these rituals, community and religion offer real comfort, meaning, and connection to the bereaved.

The Other Side of Sadness is a welcome reminder that normal grief does not need to be medicalized: for the human species, evidence of resilience is everywhere. George A. Bonanno combines a wealth of empirical research, common sense, and personal reflection to remind us that we are already equipped with the ability to cope with grief. There is no one prescribed way to do it, yet we still find the strength to pull our lives together, move past our grief and immerse ourselves in our work and our communities. The work of mourning is better done by the work of living.

that is at the core of this placebo effect. A certain portion of any treatment’s effectiveness comes from instilling hope, and it is precisely this component that is provided by taking a placebo. Since depression is in effect a condition of hopelessness, the hope instilled by the placebo effect plays the largest role in recovery. A study’s finding that “active” drugs had a statistically higher success rate than placebos may also be due to a type of placebo effect. “Active” drugs produce side effects, while inert placebos do not. A patient who feels side effects knows that he is getting the active drug, which in turn causes him to anticipate getting better. Lo and behold, he does get better, though it may be from the placebo effect and not necessarily the drug itself. When Kirsch controlled for side effects in his meta-analysis, or when “active placebos” — ones that cause side effects — are used, there was no statistical difference between patients who got better with active drugs and active placebos.

Kirsch concludes this engaging narrative of psychological detective work with a discussion of where to go from here. Since we have spent the last forty years “comparing regular placebos to extra-strength placebos,” should we continue to alter patients’ brain chemistry, and risk the side effects that come with tampering with neurotransmitters? Or should we offer them sugar pills? Or active placebos? And what ethical problems must we overcome to do so? The central message of Kirch’s book seems to be wrapped in this dilemma: if these drugs are helping people, why puncture the myth and take it away from them?

Ultimately, Kirsch suggests therapy as an appropriate alternative to clinical treatment. He argues that psychotherapy can be more effective with longer lasting results than drug therapies. To Kirsch, therapy offers hope with no need for side effects or deception. Therapy is the “quintessential placebo.”
Explaining Away Happiness
(Reprinted with permission from Stumbling on Happiness)
by Daniel Gilbert
Professor of Psychology at Harvard University.

I f you’ve ever puked your guts out shortly after eating chili con carne and found yourself unable to eat it again for years, you have a pretty good idea of what it’s like to be a fruit fly. No, fruit flies don’t eat chili, and no, fruit flies don’t puke. But they do associate their best and worst experiences with the circumstances that accompanied and preceded them, which allows them to seek or avoid those circumstances in the future. Expose a fruit fly to the odor of tennis shoes, give it a very tiny electric shock, and for the rest of its very tiny life it will avoid places that smell tennis-shoey. The ability to associate pleasure or pain with its circumstances is so vitally important that nature has installed that ability in every one of her creatures, from Drosophila melanogaster to Ivan Pavlov.

But if that ability is necessary for creatures like us, it certainly isn’t sufficient, because the kind of learning it enables is far too limited. If an organism can do no more than associate particular experiences with particular circumstances, then it can learn only a very small lesson, namely, to seek or avoid those particular circumstances in the future. A well-timed shock may teach a fruit fly to avoid the tennis-shoe smell, but it won’t teach it to avoid the smell of snowshoes, ballet slippers, Manolo Blahniks, or a scientist armed with a miniature stun gun. To maximize our pleasures and minimize our pains, we must be able to associate our experiences with the circumstances that produced them, but we must also be able to explain how and why those circumstances produced the experiences they did. If we feel nauseous after a few turns on the Ferris wheel and our explanation involves poor equilibrium, then we avoid Ferris wheels in the future - just as a fruit fly would. But unlike a fruit fly, we also avoid some things that are not associated with our nauseating experience (such as bungee jumping and sailboats) and we do not avoid some things that are associated with our nauseating experience (such as hurdy-gurdy music and clowns). Unlike a mere association, an explanation allows us to identify particular aspects of a circumstance (spinning) as the cause of our experience, and other aspects (music) as irrelevant. In so doing, we learn more from our upchucks than a fruit fly ever could.

Explanations allow us to make full use of our experiences, but they also change the nature of those experiences. As we have seen, when experiences are unpleasant, we quickly move to explain them in ways that make us feel better (“I didn’t
get the job because the judge was biased against people who barf on Ferris wheels”). And indeed, studies show that the mere act of explaining an unpleasant event can help to defang it. For example, simply writing about a trauma - such as the death of a loved one or a physical assault - can lead to surprising improvements in both subjective well-being and physical health (e.g., fewer visits to the physician and improved production of viral antibodies), What's more, the people who experience the greatest benefits from these writing exercises are those whose writing contains an explanation of the trauma.

But just as explanations ameliorate the impact of unpleasant events, so too do they ameliorate the impact of pleasant events. For example, college students volunteered for a study in which they believed they were interacting in an online chat room with students from other universities. In fact, they were actually interacting with a sophisticated computer program that simulated the presence of other students. After the simulated students had provided the real student with information about themselves (“Hi, I’m Eva, and I like to do volunteer work”), the researcher pretended to ask the simulated students to decide which of the people in the chat room they liked most, to write a paragraph explaining why, and then to send it to that person. In just a few minutes, something remarkable happened: The real student received e-mail messages from every one of the simulated students indicating that they liked the real student best! For example, one simulated message read: “I just felt that something clicked between us when I read your answers. It’s too bad we’re not at the same school!!” Another read: “You stood out as the one I would like the most. I was especially interested in the way you described your interests and values.” A third read: “I wish I could talk with you directly because... I’d ask you if you like being around water (I love water-skiing) and if you like Italian food (it’s my favorite).”

Now, here’s the catch: Some real students (informed group) received e-mail that allowed them to know which simulated student wrote each of the messages, and other real students (uninformed group) received e-mail messages that had been stripped of that identifying information. In other words, every real student received exactly the same e-mail messages indicating that they had won the hearts and minds of all the simulated people in the chat room, but only real students in the informed group knew which simulated individual had written each of the messages. Hence, real students in the informed group were able to generate explanations for their good fortune (“Eva appreciates my values because we’re both involved with Habitat for Humanity, and it makes sense that Catarina would mention Italian food”), whereas real students in the uninformed group were not (“Someone appreciates my values... I wonder who? And why would anyone mention Italian food?”). The researchers measured how happy the real students were immediately after receiving these messages and then again fifteen minutes later. Although real students in both groups were initially delighted to have been chosen as everyone’s best friend, only the real students in the uninformed group remained delighted fifteen minutes later. If you’ve ever had a secret admirer, then you understand why real students in the uninformed group remained delighted fifteen minutes later. If you’ve ever had a secret admirer, then you understand why real students in the uninformed group remained delighted fifteen minutes later.

Unexplained events have two qualities that amplify and extend their emotional impact. First, they strike us as rare and unusual. If I told you that my brother, my sister, and I were all born on the same day, you’d probably consider that a rare and unusual occurrence. Once I explained that we were triplets, you’d find it considerably less so. In fact, just about any explanation I offered (“By same day I meant we were all born on a Thursday” or “We were all delivered by cesarean section, so Mom and Dad timed our births for maximum tax benefits”) would tend to reduce the amazingness of the coincidence and make the event seem more probable. Explanations allow us to understand how and why an event happened, which immediately allows us to see how and why it might happen again. Indeed, whenever we say that something can’t happen - for example, mind reading or levitation or a law that limits the power of incumbents, we usually just mean that we’d have no way to explain it if it did. Unexplained events seem rare, and rare events naturally have a greater emotional impact than common events do. We are awed by a solar eclipse but merely impressed by a sunset despite the fact that the latter is by far the more spectacular visual treat.

The second reason why unexplained events have a disproportionate emotional impact is that we are especially likely to keep thinking about them. People spontaneously try to explain events, and studies show that when people do not complete the things they set out to do, they are especially likely to think about and remember their unfinished business. Once we explain an event, we can fold it up like freshly washed laundry, put it away in memory’s drawer, and move on to the next one.”
it up like freshly washed laundry, put it away in memory’s drawer, and move on to the next one; but if an event defies explanation, it becomes a mystery or a conundrum - and if there’s one thing we all know about mysterious conundrums, it is that they generally refuse to stay in the back of our minds. Filmmakers and novelists often capitalize on this fact by fitting their narratives with mysterious endings, and research shows that people are, in fact, more likely to keep thinking about a movie when they can’t explain what happened to the main character. And if they liked the movie, this morsel of mystery causes them to remain happy longer.

Explanation robs events of their emotional impact because it makes them seem likely and allows us to stop thinking about them. Oddly enough, an explanation doesn’t actually have to explain anything to have these effects - it merely needs to seem as though it does. For instance, in one study, a researcher approached college students in the university library, handed them one of two cards with a dollar coin attached, then walked away. You’d probably agree that this is a curious event that begs for explanation. As Fig. 20 shows, both cards stated that the researcher was a member of the “Smile Society,” which was devoted to “random acts of kindness.” But one card also contained two extra phrases - “Who are we?” and “Why do we do this?” These empty phrases didn’t really provide any new information, of course, but they made students feel as though the curious event had been explained (“Aha, now I understand why they gave me a dollar!”). About five minutes later, a different researcher approached the student and claimed to be doing a class project on “community thoughts and feelings.” The researcher asked the student to complete some survey questions, one of which was “How positive or negative are you feeling right now?” The results showed that those students who had received a card with the pseudo-explanatory phrases felt less happy than those who had received a card without them. Apparently, even a fake explanation can cause us to tuck an event away and move along to the next one.

Uncertainty can preserve and prolong our happiness, thus we might expect people to cherish it. In fact, the opposite is generally the case. When a new group of students was asked which of the two cards shown in Fig. 20 would make them happier, 75 percent chose the one with the meaningless explanation. Similarly, when a group of students was asked whether they would prefer to know or not know which of the simulated students had written each of the glowing reports in the online chat-room study, 100 percent chose to know. In both cases, students chose certainty over uncertainty and clarity over mystery - despite the fact that in both cases clarity and certainty had been shown to diminish happiness. The poet John Keats noted that whereas great authors are “capable of being in uncertainties, mysteries, doubts, without any irritable reaching after fact and reason,” the rest of us are “incapable of remaining content with half-knowledge.” Our relentless desire to explain everything that happens may well distinguish us from fruit flies, but it can also kill our buzz.

The poet John Keats noted that whereas great authors are “capable of being in uncertainties, mysteries, doubts, without any irritable reaching after fact and reason,” the rest of us are “incapable of remaining content with half-knowledge.”
John Boswell, the mind behind “Symphony of Science”

10 million views and a vinyl release later, John Boswell’s YouTube videos starring auto-tuned Carl Sagan have taken on a viral life of their own. The Cranium Cup is annually awarded to an individual who exemplifies “braininess” outside of the ivory tower. John, whose videos reach out to the innate scientific curiosity in all of us, is the deserving 2010 winner of the Cranium Cup.

Harvard Brain: Let’s start at the beginning. What first sparked the idea of using auto-tune and mashing up science videos to create these songs?

John Boswell: In the Spring of 2009, I was first exposed to auto-tune software. I had a lot of fun playing with it, and I eventually produced an album’s worth of comedic RnB/pop songs with some friends who are mostly poor singers... Around this time I discovered the work of the Gregory Brothers, of Auto-tune the News, which amazed me even more. The idea of turning spoken word into singing was a completely novel idea with seemingly endless possibilities.

I began experimenting with similar remixes, such as a Billy Mays Infomercial Ballad, before I turned to remix one of my heroes, Carl Sagan. After discovering that Carl’s voice meshes perfectly with auto-tune software, I spent a couple weeks piecing together the first song and video, “A Glorious Dawn”, and I released it in September 2009. The largely popular reception motivated me to expand and develop the science-remix theme into an entire project, and the Symphony of Science was born.

HB: What do you mean that Carl Sagan’s voice meshed perfectly with auto-tune?

JB: Carl tends to enunciate words very well, which makes it easier to understand his speech once it’s run through the tuning phase. He also has a smooth, drawn-out speaking style that lends itself very well to pitch adjusting. In addition, Carl’s poetic words are often spoken very rhythmically, which is easier to adopt to song form.

HB: Who or what are your inspirations in science and in music?

JB: My inspirations from the realms of music and science are both fairly diverse. I began my musical adventures as a DJ in a rock band in high school, being influenced by rock/indie bands (such as Radiohead) as well as electronica music (such as Aphex Twin). At college my influences expanded to include classical, jazz and other genres, while my interest in science ballooned from passive appreciation to strong passion and fascination, particularly in astronomy. It was in college that I discovered [Carl’s PBS series] Cosmos and I was immediately won over by its retro feel and Carl’s charismatic philosophical approach. I can count many other scientists as inspiration for being science-minded as well, and you can find them throughout my videos.

HB: What was your science background and did you ever consider working on the academic end of science?

JB: My formal background in science is limited to a number of undergraduate elective courses including astronomy, physics, biology, geology, anthropology, among others. I contemplated a career in the sciences but could never quite make up my mind about which field would suit me best. I ended up in economics, but am now considering an audio engineering degree, and I still wonder if it’s too late to go back.

HB: What do you view as the primary goal of your videos - educational or inspirational?

JB: The primary goal of the videos is to mix education and inspiration with entertainment... I hope to bridge the gap between education/inspiration and on-the-fly entertainment with these music videos, so people can sample some of the awe-inspiring scientific revelations without sitting down for a full feature documentary or reading a book, although that is what I strongly encourage them to do if they are interested. I know that many people have watched/read Cosmos and other related documentaries/books after being introduced to them through the videos.

HB: So do you think that as a medium, Internet videos are better suited for sparking scientific curiosity than say, books or television?

JB: Not at all, I think that all mediums
are equally important for popularizing science because they all reach different audiences, and differ in style. Documentaries and shows on TV can be a great way to introduce people to a scientific concept, and books offer a depth of explanation that internet videos and television cannot parallel. It’s essential that all three mediums are exploited to promote science.

**HB:** Have you ever come across any copyright problems with your videos? What are your thoughts on remix culture?

**JB:** There are some copyright issues going on behind the scenes, which threaten the continuation of the project, but nothing too serious at the moment. I don’t have the resources to take anything to court claiming fair use, so if these issues ever become overbearing I will have to discontinue - hopefully that day will never come. I think the remix culture is an incredibly unique and diverse form of artistic expression that is only just beginning, and I am glad to be a part of it. There is a vast potential for the development of this creative outlet and we’ve already seen some great things emerge. The future looks very promising, as long as copyright owners don’t get overzealous and squash the little guys.

**HB:** Ironcally enough, after Jay-Z proclaimed “Death of Auto-Tune,” auto-tune really seems to have taken on a life of its own outside of pop music. Instead of being used to doctor bad singing, it’s being used in these new ways - your videos and Auto-Tune the News being two examples. What do you think about this “rebirth” of auto-tune?

**JB:** The re-birth of auto-tune is a great thing in my eyes, as you may have guessed. I understand the backlash against auto-tune that Jay-Z is behind - the ubiquitous use of it to turn poor singers into pop stars overnight - but there is a lot of creative potential behind the technology beyond adjusting off-key singing, as Auto-tune the News, DJ Steve Porter, myself and others have demonstrated. In the years to come, I think we’ll see much more unique and creative things emerge that employ auto-tune, but we’ll also see studios increasingly relying on the technology as leverage to fix plain old bad singers. Like any technology, it has its upsides and downsides.

**HB:** “A Glorious Dawn” went from viral Internet video to a vinyl release. How did this happen?

**JB:** A few weeks after “A Glorious Dawn” became popular online, somebody from [White Stripes frontman] Jack White’s label Third Man Records contacted me. I was skeptical at first, but after further communication we reached a very exciting agreement to release the song on a special 45” vinyl single. Ann Druyan, Carl’s wife, was very supportive and allowed us to use a reproduction of the etching on the back of the original Voyager Record, which adds an extra dimension to the album as something of a collector’s item. I’m highly grateful for the resulting reputation boost and flattered to have worked with a musician of his caliber.

**HB:** Has social media changed the way you work and interact with fans?

**JB:** I wasn’t involved with social media much when I released the first video, but I quickly discovered how much the community has to offer in terms of ideas, recommendations and comments. I now frequently consult my Twitter/YouTube followers for sample suggestions and they always deliver; social networking has become an invaluable resource, and without it I would have to spend hours of extra time searching for just the right footage or quotes.

**HB:** What’s in store for the future?

**JB:** There are no definitive plans for the future of the project, other than to continue producing videos. I am looking to branch out musically and thematically a little bit, by including some other subjects such as quantum mechanics, paleontology, space travel, etc. There is a huge wealth of material out there waiting to be sampled, so finding enough source footage won’t be a problem. Eventually, if copyright obstacles can be surmounted, I would love to compile an album’s worth of material into a special Symphony of Science package for fans and educators.

**HB:** Any brain-themed videos planned?

**JB:** Carl Sagan, the star or “lead singer” of the series, has a whole hour long episode about the brain... [it] deserves a spot as a theme in the line-up to be sure. To me it’s one of the most fascinating fields of study today.
Depression is a disease that today affects the youngest members of society – children and adolescents – with an alarmingly high frequency, and carries with it even greater implications. One out of 33 children and one out of eight adolescents suffer from clinical depression (Sokolova, 2003). Not only are the symptoms of childhood depression expressed differently than in their adult counterparts, but the negative effects of untreated childhood depression are unique as well. Sufferers of childhood depression tend to exhibit poor interpersonal problem-solving performance and poor vocabulary retention (Sacco & Graves, 1984). Depression can also impair peer and family relationships in a classroom setting and at home. In the long-term, childhood depression can even exacerbate the intensity of other health conditions such as asthma and obesity (Van Lieshout & MacQueen, 2008; Goodman & Whitaker, 2007). Perhaps most frighteningly, depression is the greatest risk factor in suicide among children and adolescents, and is itself the third leading cause of adolescent death (AAP Policy, 2000; CDC, 2007).

Given the devastating impact of the illness, how can depression best be treated and its negative side-effects prevented? Two primary competing schools of thought exist regarding the most effective treatment methods: pharmacotherapy and psychotherapy. Pharmacotherapy focuses on providing appropriate pharmaceutical resources to relieve the symptoms associated with childhood depression. Psychotherapy, on the other hand, focuses more on the cognitive and behavioral problems that cause and exacerbate depression in children. Given that childhood depression in particular tends to be of substantial duration, with significant chances of relapse and difficulties in interpersonal functioning, it may not enough to rely on medications and pharmacotherapy to effectively combat depression in the long-term. There needs to exist a focus on the psychotherapeutic aspects of treatment in combination with pharmaceuticals.

Most modern-day treatment methods are centered around pharmacotherapy, and involve implementing anti-depressant medications like Benzodiazepine, tricyclic antidepressants, and selective serotonin reuptake inhibitors (SSRIs). However, drug-based solutions to depression – particularly childhood depression – have come under increasing scrutiny due to their questionable efficacy and potentially dangerous side effects.

Several studies on tricyclic antidepressants and SSRIs resulted in measurements of no statistical significance, in comparison with placebos given to control groups (Hazell, O’Connell, Heathcote, Robertson, & Henry, 1995). Indeed, although SSRIs are the predominant drug of choice by physicians for depression, they have been shown to be not only ineffective, but also to have significant negative side-effects. For example, studies conducted by Dr. Martin H. Teicher of Harvard Medical School comparing the effects of SSRI antidepressants with a placebo found that while suicide ideation did in fact decrease for some, another group of patients also experienced increased levels of suicide ideation. Teicher hypothesizes that antidepressants may simply “redistribute” suicide risk along a spectrum – attenuating levels of suicide ideation among some patients who respond well, but at the same time augmenting levels among other patients who respond poorly (Teicher et al., 1993).

In addition, use of SSRIs has led to problems with withdrawal. In 1993, the U.K.’s Committee on Safety of Medicines/ Medicines Control Agency reported having received “78 reports of symptoms occurring on withdrawal of paroxetine, including dizziness, sweating, nausea, insomnia, tremor, and confusion” (Committee on Safety of Medicines, Medicines Control Agency, 1998). Even in subsequent experiments involving the gradual discontinuation of the drug, withdrawal symptoms persisted, as in the case of “Julia,” for whom the dose of medicine was lowered gradually, only to result in her calling her physician two weeks later “to say that the bottom had fallen out: ‘I’m a witch again.’ She felt lousy, pessimistic, angry, demanding…” (Kramer, 1993).

Despite the many options for treatment of childhood depression in existence, there remain certain societal and environmental factors that can affect both the onset and relapse of depression that medication alone cannot fully address. One such societal factor is stigma, which has historically been one of the most formidable barriers to treating mental health, and at the same time, due to its qualitative nature, has been one of the most under-researched as well.

An alternative to the pharmaceutical treatment method for childhood depression is psychotherapy, which is often used either independently or in conjunction with drug therapy treatments. Psychotherapy is useful in helping the patient better understand and cope with factors involved in either causing or exacerbating the symptoms leading up to depression or depressive episodes. Such factors may include personal histories of abuse...
Treatments with psychotherapy for long periods of time can help patients and families consolidate the skills that they may have acquired during the acute phases of depression.

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Contributions of Traumatic Events and Memories to PTSD Diagnosis
Evidence from Psychology, Traumatic Brain Injuries and False Memories

BY ELISA DIERICKX

Both the DSM-III (American Psychiatric Association, 1987) and the DSM-IV (American Psychiatric Association, 2000) explicitly state that exposure to a traumatic event is absolutely necessary to receive a diagnosis of Post-Traumatic Stress Disorder (PTSD). However, is this the way these manuals for diagnosis should be written? Experts have long debated whether PTSD is caused by the traumatic event itself or by the memories of the event. More specifically, it is possible that the symptoms of PTSD are caused by the inability to process these traumatic memories in a normal, functional way. It is crucial to make this distinction, not only because it suggests a radical change in the way PTSD should be diagnosed, but also because it implies a profound difference in the way the patient is perceived. There is always a risk of stigmatization of the patient when, as in recent years, the emphasis shifts from PTSD as a disorder caused by an event “that would cause distress in almost everyone” (DSM-III) to the study of factors that are thought to be predispositions, such as a lower than average IQ (Breslau, Lucia and German 2006).

Cortisol & the Hippocampus
If PTSD has biological causes, such as the secretion of hormones that damages the brain, it could be useful to determine when exactly the damage occurs. If damage were observed right after the traumatic event, the theory that PTSD is caused by the event itself would be strengthened.

Although stress is not the only reason that cortisol is secreted into the bloodstream, it has been termed “the stress hormone” because it is also secreted in higher levels during the body’s “fight or flight” response to danger, and is responsible for several stress-related changes in the body. For example, in their study of Marines and Green Berets in a special survival training camp, Morgan and colleagues (2004) observed that after their mock-capture and during mock-interrogation, the soldiers had levels of cortisol similar to the levels present during a heart surgery. They also observed that these increased levels of cortisol correlated with dissociation during the interrogation, which is thought to be a predictor of PTSD (Bremner, Southwick, Brett, Fontana, Rosenheck, & Charney 1992). The theory that cortisol plays an important role in PTSD is strengthened by the fact that the hippocampus, which is strongly involved in memory processing, contains many cortisol receptors. Therefore, it has been suggested that exposure to high levels of cortisol could be harmful for the hippocampus and cause it to shrink (Carrion et al. 2007). A smaller hippocampus would then have difficulties processing certain memories, resulting in PTSD.

However, Yehuda and colleagues (1995) have argued that since the cortisol stress response is brief and adaptive, it is unlikely to damage the brain, refuting the idea that PTSD is caused by the traumatic event itself. As a matter of fact, Yehuda et al. even proposed a hypothesis that supports the theory of PTSD being caused by the memories of the event: the shrinking of the hippocampus may be caused by the cortisol secreted during the multiple stressful flashbacks experienced by patients with PTSD. However, their hypothesis remains unsupported by their results, which instead suggest that chronic PTSD is associated with low levels of cortisol (Yehuda et al., 1995).

PTSD and loss of memory
In some cases, for example during car accidents, the person suffers from a brain injury and is, as a result, completely unable to remember the event. Can these people develop
PTSD: If they do, this would strongly support the hypothesis that the disorder is caused by the traumatic event itself, and not by the memories of the traumatic event.

A study by Klein, Caspi and Gil (2003) found that, in most cases, people with traumatic brain injuries do not have any of the symptoms of PTSD. This suggests that one needs to have memories of the event in order to develop PTSD, and, as a result, that the real cause of the disorder is not the accident itself, but rather the distressing and badly processed memories. However, it is not possible to conclude this from Klein and colleagues’ study alone, as they actually observed PTSD in some of the patients who suffered from traumatic brain injury.

Nevertheless, some hypotheses can be proposed to explain these cases of PTSD in patients who have no recollection of the event. First, even though the patients may not remember the car crash itself, they often do remember the events that occurred immediately before and immediately after. It is possible that the memories of sitting in the car while desperately waiting for help are distressful enough to cause PTSD. Second, although the patients do not have real memories of the car accident, they can very well fabricate and reconstruct memories from what they hear and see around them (stories from witnesses, the wrecked car, and so on). Interestingly, these “false,” constructed memories can be worse than what the real ones would have been, due to exaggeration by the imagination. These two propositions not only support the “memory hypothesis” and explain why some people still develop PTSD despite losing their memories of the actual event, but also suggest that the memories responsible for PTSD do not even need to be “true.” Apparently, even fabricated memories can play a role in causing PTSD.

False Memories?

To further elucidate the exact cause of PTSD, an interesting subset of people to examine are those who claim to have memories of traumatic events we would certainly consider to be false. If these patients do have PTSD, then this would further suggest that there is no need for a traumatic event to occur in order to develop the disorder; all one needs are memories, which can be either real or fabricated.

Two prominent examples of this kind of situation have been studied. McNally, Lasko, Clancy, Macklin, Pitman and Orr (2004) studied the psychophysiological response of ten people who reported abduction by aliens. They measured the abductees’ physiological responses, such as facial muscle contractions and skin conductance, to the imagery scripts of a neutral biographical event, a positive event, a traumatic event, and finally the abduction. The responses of the abductees to their abduction script were similar to their responses to their traumatic event script. This suggests that people can be extremely distressed by events that never happened. It is enough to have distressing “memories,” and, as a result, to be entirely convinced that the traumatic experience happened. So would it be possible for these people to develop PTSD, if the distress is severe enough?

Takhar and Fisman (1995) reported the case of a fifteen-year-old patient presenting the symptoms of PTSD. He reported memories of multiple instances of contact with aliens, beginning at the age of three. These contacts were of a traumatic nature and included violence and sexual abuse, and the patient responded with feelings of intense fear and helplessness. He frequently re-experienced the events in the form of intrusive thoughts, nightmares and flashbacks. Again, it seems that false memories can cause PTSD. However, when Takhar and Fisman investigated the patient’s childhood history, they discovered a number of “real” traumatic events, including sexual abuse by his neighbor and multiple near-death experiences. Could these “real” traumatic events be the real cause of the PTSD symptoms, even though the subject of the flashbacks and the nightmares is the alien abduction? This case points out the need for a careful examination of the patient’s history before making conclusions about the events that triggered the disorder.

Claiming abuse by satanic cults is another case where there may be reason to doubt the veracity of the patient’s memories. In hundreds of investigations, the FBI has failed to uncover any compelling evidence that would indicate the existence of such a cult (McNally, 2003). For example, in the famous Ingram case, despite the fact that Ingram’s daughters had accused him of leading a cult that had

“These two propositions not only support the ‘memory hypothesis’ and explain why some people still developed PTSD despite losing their memories of the actual event, but also suggest that the memories responsible for PTSD do not even need to be ‘true’. Apparently, they can be reconstructed, or even false.”
murdered dozens of babies, not a single child had been reported missing, and not a single body has been found. In addition, the testimony of the family members is often contradictory, and the memories have a hallucinatory quality (Wright, 1993). Moreover, while the patients often accuse the cult of taking pornographic pictures, none of these pictures have yet been found (Stine, 1999). While there is equally no evidence that the abuse was fabricated, it is difficult to believe that cults which commit such large-scale crimes could disappear without a single trace. Since there are serious reasons to doubt that the abuse ever happened, we can conclude that the patients’ memories are probably false. PTSD much more often affects people who claim to have been abused by a satanic cult than people who think that they have been abducted by aliens. In fact, the symptoms usually worsen during the whole interrogation and trial process (McNally, 2003). Is it possible that, as the patient’s created memories gradually become more and more detailed and horrific, the symptoms grow worse? According to one hypothesis, it is. During this process of recounting the event, the patient may convince himself further of the veracity of his testimony, until he cannot differentiate true from false memories anymore. The Ingram case, as related by Wright (1993), is a convincing example of this phenomenon. While the presumed victim initially accused her father of having sexually abused her once, she later accused not only him but also his wife and his colleagues of leading a satanic cult that sacrificed and ate babies. Her testimonies often contradicted each other, and could not be verified by doctors (for example, she did not have any of the scars that she claimed to have). She gradually developed PTSD, although it is highly probable that her memories of the traumatic events are false. Such a case seems to support the idea that PTSD is the result of distressing memories, true or false, rather than by an actual event. Given the sensitive nature of PTSD, there is a pressing need for further research in the field. For example, while the secretion of cortisol in a dangerous situation does not seem to damage the hippocampus and hence cause PTSD, it is worthwhile to further study the reactions of the limbic system to stress and its long-term effects on the brain. In the case of traumatic brain injuries, it will be interesting to examine how much the stories that the victim hears about the accident may shape his “memories”, even after the event has occurred. Ultimately, a revised definition for PTSD must take into account the possibility that the memories causing PTSD may be fabricated, and therefore not indicative of an event that actually happened. "Is it possible that, as the patient’s created memories gradually become more and more detailed and horrific, the symptoms grow worse?"

References
Learning disability (LD) interventions require a careful balancing act among professionals. An LD, unlike, for example, the chicken pox, is a controversial diagnosis influenced by a number of biological, social, and environmental factors that are dealt with by different specialists who sometimes have competing interests. After a psychologist diagnoses a child with LD, much of the responsibility for ensuring the child’s progress at school then falls to the teacher. In addition, other specialists such as counselors, psychiatrists, and speech-language pathologists are often enlisted depending on the specific needs of the child. Getting any of these services can be severely limited by social barriers such as poverty, family instability, and lack of school resources, leading to the frequent involvement of social workers and lawyers. Finally, parents and other family members play a crucial role in reinforcing their child’s progress in the home.

Because learning disabilities require such multifaceted interventions, the division of expertise among this long list of specialists presents a challenge to the design of unified intervention plans tailored to a child’s specific needs. There has been a historic tension between the fields of medicine and education with regard to LDs (Kavale, 1998; White, 2002). While the special education system in the United States has been formally established since the passage of the Individuals with Disabilities Education Act in 1975 (AACAP, 2008), the category of “learning disabilities” has only recently been considered for inclusion in the official diagnostic handbook of mental health professionals, the DSM (APA, 2010). This tension is further reflected in the current lack of collaboration among specialists and teachers, resulting in disjointed interventions (Clegg & Ginsborg, 2006; Todd & Gilbert, 1995). These separations can be attributed to a variety of personal, functional, and structural barriers embedded in the culture and administrative organization of schools and other service providers (Law et al., 2001; McCartney, 1999; Wodrich & Schmitt, 2006; Wong, 1991). This discussion will focus on the functional and structural barriers, because they result in a form of structural violence; that is, they are products of the very society which exists, one must first examine the political and social forces that have shaped the discourse on learning disabilities. In particular, there has been considerable tension between scientists and educators with regard to the classification and treatment of learning disabilities. Psychologists diagnose learning disabilities based on gaps between cognitive ability (as measured by IQ scores) and learning (as measured by achievement tests). If cognitive ability is measured to be higher than educational achievement by a certain amount, a child is considered learning-disabled (White, 2002). However, this seemingly clear-cut definition, which has prevailed for many years, remains fraught with controversy. Proponents of a more scientific understanding of learning disabilities argue that there is too much emphasis on advocacy and provision of services, and not enough on classification (Kavale, 1998). On the other hand, some believe that the medicalization of LDs unnecessarily limits the focus to remediation rather than acknowledging the political factors at play (White, 2002). One political factor which has led to disagreements on the definition of LDs is that the diagnosis of learning disabilities is based on IQ and academic test scores rather than biological abnormalities, so diagnosis is inherently subject to changing views on what constitutes low scores (Wong, 1991). Furthermore, clinical

“The barriers among disciplines involved in learning disability interventions create a form of structural violence.”

Context of LD

In order to understand why the barriers to collaboration among individual specialists
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The categorization of learning disabilities is often generalized for administrative purposes. For example, two children who are both broadly labeled as having a “specific learning disability” or SLD will likely have very different kinds of learning issues. However, they will probably be grouped together to indicate that they are both eligible for special services (Wodrich & Schmitt, 2006). In other words, the classification of LDs is a social construction based on the particular interests of those who create the labels.

Although current scientific definitions of specific LD categories lack a true biological basis, LDs still tend to be construed as objective and apolitical. The concept of LD was introduced in 1962 (Wodrich & Schmitt, 2006) as a way to attribute particular problems at school to a presumed neurological impairment when a child’s IQ levels were normal (Kavale, 1998). In other words, LDs were typified as a social construction based on assumptions that were never actually scientifically proven. The assumed biological basis allowed the LD diagnosis to be viewed as a legitimate reason for a struggling child to receive extra support at school, and over time, the definition of LD was adapted to fit the interests of advocates and service providers who wanted to package LD more simply as a “discrepancy” in school performance (Kavale, 1998). This allowed the existence of the LD category to legitimize the work of LD professionals and maintain a child’s dependency on their services (White, 2002). Therefore, the construction of an “objective reality” of LD was in fact highly dependent on political factors throughout its history.

The Sociality of LD

How do these societal forces manifest themselves at the level of the individual service provider? Functional and structural barriers are most relevant to the topic of how social constructions influence LD interventions. Functional barriers include the fact that teachers emphasize “inclusion,” or the concept that every child should have an equal share of educational services, while speech-language therapists (SLTs) operate under a model of “caseness,” providing services to only those students who have been identified as language-deficient (McCartney, 1999). Therefore, a teacher may view an LD child’s individual difficulties as outside of their realm of responsibility, preferring instead to focus on the learning environment of the whole class (Wong, 1991). On the other hand, an SLT is trained to evaluate each child’s unique problems and formulating a plan, much like how doctors treat other medical conditions (McCartney, 1999). These professionals are simply acting the way they were trained to, indicating the need for reform in prevailing institutional models: the professionals (Wong, 1991; Law et al., 2001; Wodrich & Schmitt, 2006). Based on teacher surveys, the number one barrier is the lack of time available for meeting with a team to discuss individual students’ difficulties (Bos & Vaughn, 1998; Wong, 1991). The differing terminology used by different fields relates to the aforementioned concept of service providers redefining LDs to fit their goals. While school psychologists prefer broader labels, such as specific language impairment (SLI) to indicate eligibility for certain special education services, speech-language pathologists tend to apply more specific diagnoses, such as language pragmatics deficits, that are not as readily comprehensible to non-specialists (Wodrich and Schmitt, 2006). The absence of administrative support, which leads to a lack of funding for training in collaboration, presents a particularly difficult challenge. Without the structural basis for collaboration, individual practitioners are left to motivate themselves to set up meetings and to work together on designing interventions. Farmer (2006) points out that “[m]edical professionals are not trained to make structural interventions,” and neither are teachers. Even when specialists recognize the need for working with others, collaboration is often so difficult to carry out due to the listed barriers that they often return to individualized specialization after attempting collaboration (Clegg & Ginsborg, 2006). Because individual service providers have limited agency, the bureaucracies involved must take responsibility in order to begin breaking down the barriers to collaborative LD interventions. Without the help of the institutions that support their work, teachers and health specialists simply lack the knowledge and resources needed to work together.

Now that the barriers to interdisciplinary collaboration have been established as resulting from structural factors, the ability of these structures to stop children from reaching their fullest potential must be demonstrated in order to fulfill the definition of structural violence. In order to judge the necessity of collaboration among LD special-
ists, we must search for examples of how a lack of collaboration negatively influences the success of interventions. Children with learning disabilities have been shown to be at a higher risk of developing mental health disorders (Patel, Flischer, Hetrick, & McGorry, 2007) as well as behavioral problems (Stringer & Clegg, 2006), so it is crucial that interventions are designed to address each of these conditions concurrently. However, it has been found that children with a dual diagnosis receive the worst service (Todd & Gilbert, 1995). This is partially due to the fact that categorizing a child as LD tends to set him or her apart from others when it comes to evaluating emotional and psychiatric difficulties, so that he or she is less likely to obtain the necessary services (1995). Put another way, an LD child is to some extent seen as the “other,” incapable of experiencing the same emotional difficulties that are more likely to be treated in a child who does well in school. However, there is in fact evidence that children with lower cognitive functioning levels are less able to cope with trauma and are thus more vulnerable to emotional stress (1995). Inadequate service can also result from the opposite situation, when children who are first referred to behavioral services have language problems that go undetected because behavioral specialists view them as a byproduct of poor behavior (Clegg & Ginsborg, 2006). As a result, their language deficits will persist and may even worsen due to a lack of appropriate therapy. Even when children are referred to the appropriate services, parents may perceive the lack of collaboration between schools and health services, which can sometimes lead to dissatisfaction and uncertainty about whether their child is receiving a well-designed intervention (Law et al., 2001). If the goal of an LD intervention is to improve a child’s long-term academic and social skills, then it is crucial that the parents agree with the service provisions, since they will ultimately be the ones responsible for ensuring that the services satisfy their child’s needs. These consequences of inadequate collaboration can and should be addressed in order to reduce the structural violence inflicted on LD children and ensure that they do reach their fullest potential. In fact, there have been several attempts at integration, documented in both the literature and in my own observations. Returning to the example of children who have language difficulties in addition to behavioral issues, Cross et al. (2001) conducted a case study of a collaborative intervention team consisting of a foster family, a teacher, a speech and language therapist, a psychotherapist, and a social worker, and the impact of their collaboration on one child struggling with behavioral outbursts and communication difficulties. The researchers found that collaboration among these specialists allowed each member of the team to learn strategies from the others to identify the child’s difficulties that they otherwise would not have noticed, which led to the creation of a more comprehensive intervention. Over time, this not only improved the child’s communication and behavior, but also boosted his confidence.

Of course, this case study of just one child does not provide enough information to demonstrate that interdisciplinary collaboration could be successfully implemented on a larger scale, and it does not address the necessity of shifting administration to the staff and SLTs. Together, these two studies demonstrate that collaboration among professionals can be successful not only when children are treated one-on-one as in a medical model, but also when specialists are integrated into classroom settings to provide guidance to educators. The results of these case studies are mirrored by other investigations into how collaboration among specialists can best be achieved. Government-funded research on collaboration between education and health services in the United Kingdom concluded that collaboration on an individual level is effective as long as practitioners have a clear understanding of each other’s roles (Law et al., 2001). This can be accomplished through training programs to educate specialists on how others in the field of education can complement their work. The majority of the literature focuses on speech and language interventions, but these concepts can be applied to interventions for other types of learning disabilities as well. For example, public schools in the United States are required by law to hold Individualized Education Program (IEP) meetings for any student who is deemed eligible for special education based on testing results, and these

“The true progress relies on changing the institutions in which LD service providers work so that they are held accountable for providing quality interventions that are the result of interdisciplinary planning and implementation.”
meetings are attended by a team consisting of a general education teacher, a special education teacher, any clinical specialists who have evaluated the child, and the parents (Gregg & Lindstrom, 2008). Since this collaborative meeting is required by law, it is certainly not limited to resource-rich settings, and it even reconvenes every year to assess the child’s progress and make any necessary changes to the intervention plan.

Because IEP meetings are held in all public schools, one may question the validity of the previous discussion on the lack of collaboration and barriers to collaboration that exist in the context of LD interventions. However, there is a major limitation of the IEP meeting. Since the IEP team is only required to meet once a year and health providers are not required to be present at the meetings, teachers and health providers still do not interact on a regular basis. Also, the laws governing IEPs do not clearly specify the extent to which services should be provided, only dictating that “reasonable” and “appropriate” accommodations be made (Wodrich & Schmitt, 2006). Therefore, the quality of the interventions that are implemented depends heavily on the school. Even so, the IEP meeting could be used as a model to devise ways to increase multidisciplinary collaboration without requiring a large amount of resources.

Together, these forces represent a structural foundation that can encourage different specialists to work together. These factors could be harnessed to further increase collaboration and thereby reduce the structural violence that too often hinders LD children’s educational and behavioral development. Laws are powerful motivators, but for reasons already stated they are not enough to ensure that children receive the most comprehensive services. True progress relies on changing the institutions in which LD service providers work, so that they are held accountable for providing quality interventions that are the result of interdisciplinary planning and implementation. In the U.K. study, developing joint strategic plans and implementing common data sets were recommended as crucial to institutionalizing collaborative efforts at the managerial level based on observations of what has worked in the realm of speech and language therapy in England and Wales (Law et al., 2001). Both of these strategies would contribute to the overall efficiency of an institution as a whole, which would then give individual professionals the structural context and support needed for forming collaborative networks. In addition, the broader societal discourse about the dichotomy between science and education can begin to be challenged as well, as more schools and medical centers adopt the model of mutual support.

The complex, multidisciplinary nature of LD services necessitates that barriers to collaboration among different types of providers be reduced, to improve the quality of care for children. While these barriers are deeply rooted in structural forces, several studies have demonstrated the possibilities for increased collaboration their positive outcomes (Clegg & Ginsborg, 2006; Tollerfield, 2003; Cross et al., 2001). These existing models can and should be adapted on a larger scale in order to shift the discourse to focus on the interactions rather than the differences between education and medicine. Improving LD interventions should be considered a public health goal and an educational goal, with the understanding that these categories are not mutually exclusive.

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Constituent Objectification & War: How Leaders’ Attitudes Affect Interstate Security

By Debbie Lin

Whether in ancient Mesoamerica or in modern Iraq, war has been a frequent and devastating part of civilization. On average, approximately a hundred militarized incidents between two or more nations have occurred every year for the past decade, with five wars reaching over one thousand casualties between 1991 and 2001 (Ghosn & Palmer, 2003). While the concept of war is certainly not new, what is more rarely addressed is the question of why war occurs. From a rational standpoint, warfare is immensely disadvantageous. The losers make substantial, even humiliating concessions, while all parties typically suffer massive casualties and lost time and resources. The phenomenon of war becomes even more puzzling at the level of the constituents of the states in conflict. The citizens of warring states are the ones who suffer from rationing, live in fear of invasion, and work in munitions factories, undergo brutal military training, and die for their leaders’ decisions to wage war. If they collectively refused to work, to fight, or generally to obey, war could not be. Yet, these refusals very rarely occur.

Thus, the conundrum of why there is so much interstate conflict encompasses two levels: why leaders make the apparently irrational decision to wage war when there might be other options available, and why constituents collectively make the equally irrational decision to support the war. Although this question undoubtedly has a complex answer, an important part of the response should consider the “top-bottom” relationship between a country’s leadership and its constituency. More specifically, belligerent leaders may view their constituents as objects over which to exercise power, a condition called “objectification.” When any group considers others to be mere objects to be exploited, the group typically feels no qualms about making choices that could hurt the objectified. In an analogy, chess players rarely mourn the pawns they sacrifice in a match: citizens of the country become human pawns. In this paper, I argue that objectification affects a leader’s attitude toward both policy and his or her constituents, and that a leader’s objectification of the constituents increases the potential for interstate conflict. From the constituent’s perspective, internalizing objectification decreases moral resistance to acts of war and increases compliance with the leadership’s policies.

Deindividuation is one step short of objectification, because deindividuation does not necessarily involve the manipulation of individuals or populations as objects, even though it is still a good marker for objectification. “Dehumanization” is an extreme form of objectification that goes beyond objectification’s passive process to completely and actively strip the objectified person of human qualities.

Consequences of Objectification to the Leadership

When leaders objectify their constituents, leaders can more easily make decisions that could jeopardize the well-being of the constituents. Deindividuation is one step short of objectification, because deindividuation does not necessarily involve the manipulation of individuals or populations as objects, even though it is still a good marker for objectification. “Dehumanization” is an extreme form of objectification that goes beyond objectification’s passive process to completely and actively strip the objectified person of human qualities.

Theoretical Background

The subject of interstate conflict has generated a substantial body of scholarly work, most of which fall into two distinct categories. One category encompasses studies that take the “top-top” perspective, looking at factors that affect how a country’s leadership makes decisions. The other category, termed “bottom-bottom,” considers the constituents. The “top-bottom” perspective that considers the relationship between leaders and constituents, however, has been largely neglected; yet this is vital to a fuller understanding of the causes of warfare, for no wars can occur if the leaders do not decide to engage in war and the constituents to enable war. Therefore, to fully understand the concept of war, we must synthesize aspects of the leader-centered and people-centered views of warfare.

To clarify the discussion, I define some key terms. “Nation” and “state” both denote sovereign, political entities with substantial control over its subjects. “Leader” refers to any individual with executive power over a nation, especially over its foreign and military policy. “Constituent” is a broad term for a member of the state with limited power over its decisions. “Objectification” means viewing another individual or members of another group as “objects” less worthy of moral consideration or autonomy. “Deindividuation” refers to a loss of ability to distinguish among individual members of an outside group.
Constituent Objectification and War

Consequences of Objectification to the Constituency

Objectification does not merely enable aggressive decisions that risk constituents’ well-being; it actively encourages such choices. In a 2004 study of policemen, Euwema et al. measured the degree of burn-out among the officers using standard cognitive and decision-making tests. They equated the degree of burnout to loss of dominance, and found a corresponding drop in the number of unnecessarily aggressive decisions in the field. In other words, more dominant officers made worse decisions, in the sense of incurring greater dangers and risks. In the same way, when leaders gain dominance through objectification, they are more likely to make excessively aggressive decisions, which translate into aggressive policies and even conflict. Objectification itself may play a direct role in causing leaders to want to show off or test their dominance through war. After all, the potential benefits of war include glory and power for the winner. These usually do not seem to be worth high death tolls and other potential costs, but if leaders feel dominant, they may underestimate and undervalue potential risks. In addition, if they strongly objectify their constituents, the people’s suffering or deaths would seem less of a potential cost, causing the leader to further underestimate risks. This dangerous combination of lower perceived cost and greater desire for benefit could make war a more attractive option.

Even if leaders somehow realized the errors of an aggressive policy, perhaps through constituent protest, their objectification of their constituents undermines the possibility for a diplomatic resolution. Guisinger and Smith (2002) examined the credibility and success of diplomatic overtures through a series of robust game theory models tested against historical crises. They demonstrated that diplomacy is more effective when a nation has a strong reputation for carrying out promises and threats. Upon analyzing how results differed by type of government, Guisinger and Smith (2002) noted that leaders that were more accountable to their constituents were more successful in negotiations. They concluded that this greater success was because more empowered constituents would hold their leaders responsible for reneging on agreements. Hartnett (1971) had already established that when they have power to influence decisions, constituents tend to affect ones that would reduce risks to their well-being. From this conclusion, the Guisinger and Smith (2002) results make sense on three levels. First, reneging on agreements often brings sanctions from other countries or other measures costly to the constituency. Second, the loss of credibility in the international arena often brings long-term risks to a nation’s well-being, such as diminishing prospects for future negotiations. Finally, if diplomacy fails due to broken accords, war or other high-cost measures are likely to ensue. Thus, Guisinger and Smith (2002) and Hartnett (1971) together suggest that states are less prone to conflict when the top-bottom relationship is bilateral. Because objectification inherently disempowers constituents, it undermines diplomacy. Diplomacy is perhaps the single greatest tool for averting interstate conflict. When it fails due to objectification, war is much more likely.

Concurrently, the Harvard Brain

Debbie Lin

Curs frequently due to the imbalance of power between the two groups. In one study, the researchers randomly assigned subjects to a high-power or low-power position, then carried out cognitive tests while the subjects were involved in a two-person role-playing game. The study showed that the high-power individual tended to deindividuate and objectify the low-power individual when executing an organizational task, rather than engage in a collaborative or inspirational leadership mindset. Holding power was enough to cause the average subject in the high-power position to see the powerless subjects as nameless entities whose sole purpose was to serve the organization. Running a nation and choosing foreign policy are organizational concerns, so this suggests that the top to bottom relationship will be objectifying.

The consequences of this objectification are drastic, as Philip Zimbardo’s classic and controversial 1971 study demonstrates. Commonly known as the Stanford prison experiment, Zimbardo’s study randomly assigned a group of average undergraduate students to be either “prisoners” or “guards”. The prisoners were stripped of their identities, and the guards were given near-absolute control over them in a mock prison. The study was aborted within days since the guards quickly committed serious physical and emotional abuses on the prisoners, including refusing to allow them to urinate and defecate, forcing them to go nude around the prison, and subjecting them to sexual humiliation. In addition, the guards subjected the prisoners to extreme dehumanization, by forcing them to recount their prisoner numbers over and over again, thereby emphasizing the fact that they had no names, only numbers. From these results, Zimbardo concluded that the sadistic actions of the guards happened primarily because the study’s setup had set up an extreme hierarchy that afforded absolute power of one group of people over another. Indeed, this study can be seen as a microcosm for a state with a sharp top-bottom divide and strongly objectified constituents. Human worth is the fundamental assumption of any humane society; removing this obstacle also removes the greatest barrier to war.

Objectification does not merely enable aggressive decisions that risk constituents’ well-being; it actively encourages such choices. In a 2004 study of policemen, Euwema et al. measured the degree of burn-out among the officers using standard cognitive and decision-making tests. They equated the degree of burnout to loss of dominance, and found a corresponding drop in the number of unnecessarily aggressive decisions in the field. In other words, more dominant officers made worse decisions, in the sense of incurring greater dangers and risks. In the same way, when leaders gain dominance through objectification, they are more likely to make excessively aggressive decisions, which translate into aggressive policies and even conflict. Objectification itself may play a direct role in causing
failure, none of the participants stopped the experiment. Milgram explained that it is easy for individuals to justify their own morally questionable actions under the rationale that these actions are too small to matter, or that they were simply following orders given by an authority figure. Thus, their objectification strips them of their moral agency, so that they do not feel responsible for immoral acts that they may commit. This suspension of personal responsibility may help explain how average citizens in the military can commit crimes such as torture, rape, and murder. In addition, objectification places the objectified in a group - or in this case, a constituency - that makes more aggressive decisions than would an individual. In an illustration of how aggregate decisions are usually more extreme than individual decisions, Meier and Hinsz (2004) conducted a study in which groups or individuals decided how much hot sauce to force another party to eat. The groups tended to decide on larger quantities of hot sauce than did the individuals in the group. Even if an individual had qualms about something morally questionable, in the greater group, those seemed to disappear altogether from decision-making. Therefore, the undermining of moral resistance through objectification removes a major check to conflict.

Indeed, objectification actually increases compliance with potentially detrimental decisions. Brockner et al. (2001) examined political crisis data from a diverse group of countries and coded for power distance, constituent voice, and negative reaction, avoiding any a priori assumption of any relationship. They found that in governments with a large power distance - that is, those that keep a rigid top-bottom divide and generally objectify the constituents more - and low constituent voice, there is little negative reaction to oppressive or dangerous policies. One of the countries that was highlighted as an example of inaccessible power structures and suppression of personal freedoms was China. From Brockner et al.'s data, the constituents of such states did not resist government decrees or withdraw from civic participation and such supportive activities, even after controlling for coercion as a variable. Perhaps this is because the high potential cost of resistance for them, such as imprisonment, is far less than the expected benefits. Thus, even in situations that are detrimental to their freedom and well-being, objectified constituents are not likely to resist.

**Conclusion & Implications**

Objectification has broad impacts: it undermines human worth, encourages aggressive decision-making, undermines peace-preserving diplomacy, removes moral resistance to inhumane actions, and encourages compliance to the extent of abetting crimes against humanity. As a result, objectification contributes to war by raising the likelihood of leaders instigating conflict and constituents engaging in it.

It should be of no surprise, then, that the militaries of every country in the world are some of the most disciplined and objectified groups in their respective nations. These professional fighting forces are primed to make war, and their commanders strategize on how to use them to best do so. Perhaps it is inevitable that these groups should exist. In the heat of battle, it is necessary to obey orders implicitly. But what is not inevitable is the extension of this militarized conscience of unquestioning obedience into the national consciousness. The conclusion that leaders who objectify constituents make war more likely ultimately means that decreasing the top-bottom divide and reclaiming constituent voice can help guard stability. Raising governmental transparency and information access, for instance, would likely have diminished American support for the war in Iraq in 2003. Yet even the status quo bears some promise for a peaceful society. Since freedom of speech and freedom of the press decrease objectification and empowers the people, constituents were able to learn, for example, that Iran is in fact pursuing peaceful nuclear ambitions currently. The lower threshold of power separating the top from the bottom may have helped prevent hawkish leaders from pushing the nation into war with Iran. It is similarly difficult to imagine that an empowered North Korean population would permit the status quo, in which the leader ignores starving constituents, preferring to spend virtually all of North Korea's GDP on its military, nuclear technology, and missiles that threaten East Asian and Pacific Rim security. In this case, the top-down divide is strictly maintained through censorship and threats of imprisonment in gulags, and constituents are objectified as supplicants to worship "Our Dear Leader." Empowering those at the bottom of each individual state to defend their vital interests and hold the top accountable could ultimately enable security in the international arena.

**References**


The Sweetest Diet: How Glucose Impacts the Limited Resource Model of Self-Control

BY STEPHANIE KAPLAN

In the last decade, dieting has become a cultural obsession. Dieting refers to the practice of restricting one’s food or calorie intake in the hopes of losing weight. Through celebrity pop culture, programs like Weight Watchers, and countless reality television shows, dieting has become a hallmark of our country and almost a pastime in itself. According to the 2008 Food & Health Survey, three-quarters of Americans are concerned about their weight, and over half of Americans are actively trying to lose weight (ific.org). Even so, the percent of overweight and obese adults in the United States has continued to climb, reaching 32.7% and 34.3% respectively in the 2005-2006 National Health and Nutrition Examination Survey.

To diet successfully requires incurring costs in the short-term, such as refusing a delicious piece of chocolate cake, in order to receive benefits in the long-term, such as better health - decisions that people consistently fail to make. To make such decisions requires self-control, the process through which people alter their actions to promote the attainment of personal goals, plans, or standards (Heatherton & Baumeister, 1996). Exercising self-control requires us to see past our short-term impulses in order to attain our long-term goals, a process that is inherently difficult due to the increased salience of events that are closer in time (Baumeister & Scher, 1988). Self-control is helpful and necessary in the pursuit of a healthy life-style; it allows us to save money for future use and to study so that we can go to graduate school someday. Yet, as evidenced by the fact that people regularly get themselves into debt and drop out of school, self-control is something at which we all too often fail.

To understand our failure at self-control, it is first necessary to understand the way self-control operates. Research has demonstrated that our capacity for self-control is a limited and depletable resource (Baumeister, Heatherton, & Tice, 1994). We possess only a certain amount of self-control, which can be divvied out to different domains; exerting self-control in one domain reduces the amount of it we have left over to exert in another domain. In other words, performing one self-control-requiring task makes a subsequent self-control-requiring task more difficult to complete.

A number of studies have lent support to this limited resource model of self-control. In one study, participants who were asked to suppress thoughts or emotions on an initial task performed worse on a subsequent self-control-requiring task in a number of different domains: academic (persisting at unsolvable anagrams), physical (squeezing a hand grip), and emotional (suppressing emotion during a humorous video) (Muraven, Tice, & Baumeister, 1999). The limited resource model has also found support in studies conducted in the domains of aggression (Dewall, Baumeister, Stillman, & Gailliot, 2007), sexual restraint (Gailliot & Baumeister, 2007), and consumer spending (Vohs, et al., 2008). In all of these studies, the participants’ capacities for self-control had been depleted by the initial task, and so were unable to muster the self-control necessary to perform well on the task that followed. In addition, studies have shown that breakdown in self-control usually occurs at night, when resources have undergone depletion: for example, dieters usually break their diets in the evening, and individuals commit more violent crimes at night (Baumeister, 2002).

If the limited resource model accurately explains the way our capacity for self-control functions, what, then, can we do about it? Given the prevalence of failed diets, impulsive spending, and under-used gym memberships, among other evidence, it is clear that we are not using our self-control resource at the optimal level. Since increased self-control is desirable in all of our lives, how can we increase our ability for self-control within this limited resource framework so that we can more often realize our long-term goals? Recent research has begun to elucidate possible answers.

Within the limited resource model is the concept that, like a muscle, one’s self-control can be strengthened through exercise of this ability. In one study, participants were assigned to complete a self-control exercise (monitoring posture, regulating mood, or recording eating) over the course of two weeks, and their performance on a task requiring self-control (squeezing a hand grip) was recorded both before and after the intervention (Muraven, Baumeister, & Tice, 1999). The researchers found that participants who had engaged in a self-control exercise were able to exert more self-control following the two-week period than were participants in a control group. In other studies, participants who engaged in a financial monitoring program or a study intervention program designed to increase self-control demonstrated increased self-control following a depleting task as compared to control.

“Three-quarters of Americans are concerned about their weight, and over half of Americans are actively trying to lose weight... Even so, the percent of overweight and obese adults in the United States has continued to climb.”
groups (Oaten & Cheng, 2007; Oaten & Cheng, 2006). Other research has found that alternative pathways using mindfulness, relaxation, or meditation techniques increase self-control (Masicampo & Baumeister, 2007, Sharma, Yadava, & Hooda, 2005).

These findings all provide possible ways to increase our ability for self-control over time, so that in any given situation, the reserve pool of self-control that we draw from is larger. However, it is also necessary to examine the issue from a more myopic perspective; that is, in a given moment when one’s self-control is depleted, what can one do to counteract this effect and enable oneself to succeed in a self-control task? In addition to the long-term interventions described above, what can one do in the short-term to beat the system?

While one’s ability for self-control can replenish on its own with sleep and rest, people are often required to perform task after self-control-requiring task without a chance for this natural replenishment to occur (Baumeister, 2002). Because of this, we too often fail to achieve long-term goals such as weight loss, since our pool of self-control that is necessary to adhere to a diet is depleted. Unfortunately, it seems that many people are unintentionally doing something that may further thwart their ability for self-control: consuming sugar substitutes.

Sugar substitutes like Splenda have long been touted as effective routes to weight loss, since they theoretically provide the same flavor of real sugar without the calories (Men’s Health, 1991). Research in the past few years, however, has begun to cast doubt on this idea of sugar substitutes as an aid in weight loss. A 2005 study garnered national press attention for its finding that consumption of diet soda was correlated with weight gain in adults through a longitudinal study over the course of eight years (Fowler, 2005; Kordella, 2005). The study found that for each diet soda a participant drank per day, he was 65% more likely to become overweight and 41% more likely to become obese over the next seven to eight years compared to a participant who drank non-diet soda. The researchers suggested that consuming a diet drink could cause people to feel more entitled to indulge in other foods since they had saved calories on the diet drink. It was also proposed that consuming sugar, as opposed to a sugar substitute, signals to the body that nutrients have been received, causing one to stop eating sooner.

Most recently, another link between sugar and the body has been examined: that between blood glucose level and self-control. In a series of nine studies, researchers examined how the consumption of a glucose drink would impact participants’ self-control (Gailliot, et al., 2007). They first discovered that acts of self-control reduced blood glucose levels and impaired performance on subsequent self-control tasks. In addition, when given a drink after a depleting task and before a subsequent self-control task, the participants who ingested the drink made with glucose fared far better on the second task than did those who ingested the drink made with the sugar substitute. In another study, the researchers found that increasing participants’ blood glucose levels through sugared lemonade as opposed to lemonade made with a sugar substitute improved performance on a decision-making task following an initially depleting task (Masicampo & Baumeister, 2008). These findings suggest that blood glucose level may be inextricably linked to our capacity for self-control. While dieters may think they are saving calories by choosing Splenda over sugar, in reality it may be the Splenda that impairs their ability for self-control and causes them to stray from their diets, leading them to consume more calories and gain more weight.

Further research is needed to better understand the effects of blood glucose levels on self-control. Research must ascertain what blood glucose levels are necessary for self-control, and whether that level is specific for each individual. In addition, the timetable under which self-control, its depletion, and its replenishment operates must be investigated. Through the integration of the various self-control interventions that have been discussed, we may ultimately arrive at a comprehensive program that can be used to increase our ability for self-control, thereby attaining the optimal levels of efficiency, health, and well-being that we wish for. So the next time you’re at the office coffee stand, indulge yourself with a thirty calorie packet of sugar - it just may save you 3,000 calories at the buffet.

References


While dieters may think they are saving calories by choosing Splenda over sugar, in reality, it may be the Splenda that impairs their ability for self-control and causes them to stray from their diets, leading them to consume more calories and gain more weight.”
Psychological Tools in Tobacco and Alcohol Advertisements

Tommy Balcetis

Background: Tobacco and alcohol advertisements both exert a great deal of influence on our decisions to consume these products, despite their destructive effects on our health. However, the methods with which tobacco and alcohol companies reach out to their target audiences are very different. The differences stem from the fact that smokers and drinkers are not persuaded by the same influence tactics. The following research aims to answer how tobacco and alcohol companies choose to maximize the appeal of their products and clarify the psychological reasons behind such marketing choices.

Methods: Two samples of alcohol and tobacco advertisements in magazines were collected and then carefully categorized as either stressing independence or interdependence.

Results: One main theme emerged from the data: tobacco advertisements place strong emphasis on independence-related images, while alcohol advertisements more often utilize images of interdependence.

Conclusion: Tobacco advertisements seek to reduce the cognitive dissonance associated with the harmful effects of smoking. Images of beauty, independence and style provide people with a sense of inner-satisfaction which distracts them from the reasons for quitting. Alcohol companies, meanwhile, incorporate the idea of alcohol as a “social lubricant” into their advertisements. Images that stress interdependence and social acceptability are therefore relatively more abundant.

Have you ever looked at advertisements for cigarettes or alcoholic beverages? Tobacco and alcohol companies, like most companies, entice the public with colorful designs, witty messages and attractive figures in order to generate positive reactions to their products. However, in the case of tobacco and alcohol, the advertised products are known to be detrimental for the user’s health, and so the advertisements must tackle the difficult task of persuading people that the benefits of consuming tobacco and alcohol outweigh the costs. Some advertisements play on fears of social exclusion if an individual chooses not to consume the product; others focus on promoting self-esteem by featuring images of beauty, style and freedom. Is one of these approaches more specific to a certain industry? The hypothesis of the following study hinges on the idea that tobacco and alcohol companies choose particular psychological tools in order to influence people’s decisions to consume their products. Namely, tobacco advertisements use images that tend to stress beauty, style, and independence, while alcohol advertisements put more emphasis on images of social acceptability.

FIGURE 1.1 Pleasing images of independence, focusing on beauty, freedom and wealth are often associated with tabacco advertisements.
acceptance and group behavior.

Method

Materials: The “subjects” of the study were tobacco and alcohol advertisements found in popular magazines and on the Internet. In total, 101 advertisements were examined: 54 tobacco advertisements (representing only the most popular brands such as Marlboro, Lucky Strike, and Camel) and 47 alcohol advertisements (such as Jack Daniels, Smirnoff, Finlandia, and others). The ads were extracted from the following magazines: Cosmo, Newsweek, Allure, and Men’s Health. Phrases “tobacco advertisements” and “alcohol advertisements” were run through the Google image search engine in order to generate relevant websites.

Procedure: The selected advertisements were categorized into two groups: those stressing social “independence”, and those stressing social “interdependence”. Advertisements were considered “socially independent” if the number of people featured was zero or one, or the advertisement stressed singular “self” words such as me, mine, or you. Conversely, advertisements were considered “socially interdependent” if two or more people were observed or plural words, such as we, us, or they were used. Examples of the advertisements and their categorizations are presented in Figure 1.1 and Table 1.1.

Discussion

The results of this study support the idea that there is a clear difference in the way tobacco and alcohol companies advertise their products. Tobacco companies more often use independence-related images in their advertisements, while alcohol advertisements more often use interdependence-related images. Current research suggests that cognitive dissonance and social proof theories may be the underlying reasons behind these kinds of marketing choices. In a study carried out by Michael G. Ho at the University of California, the researchers found that smokers justified smoking by striving to identify themselves with “glamorous and elegant” smoking celebrities (Ho et al., 2007). Such statements are textbook examples of the cognitive dissonance theory, which predicts that people make up reasons to justify behavior which goes against their belief system. Ho’s findings provide a reasonable explanation for why tobacco companies use images of beauty and independence in their advertisements: these images allow people to rationalize their behavior, despite the obvious known health risks of smoking.

Table 1.1 Classification of different advertisement techniques included in study

<table>
<thead>
<tr>
<th>Independence</th>
<th>Interdependence</th>
</tr>
</thead>
<tbody>
<tr>
<td>None or one person in the advertisement</td>
<td>More than one person in the advertisement</td>
</tr>
<tr>
<td>Words emphasizing self e.g. me, my, you, yours</td>
<td>Words emphasizing companions e.g. we, us, they</td>
</tr>
</tbody>
</table>

Table 1.2 Association test between advertisement technique and industry (N = 101)

<table>
<thead>
<tr>
<th></th>
<th>Independent</th>
<th>Interdependent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>38</td>
<td>16</td>
<td>54</td>
</tr>
<tr>
<td>Alcohol</td>
<td>17</td>
<td>30</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>46</td>
<td>101</td>
</tr>
</tbody>
</table>

\[ X^2: 11.851 \quad P\text{-value: 0.0012} \]

Assuming a significance level of 5%, this p-value represents a significant difference in the types of advertisements that tobacco and alcohol companies use.
Alcohol companies use a different psychological technique to market their products: the theory of social proof. The idea behind this theory is that no one wants to be left out of a social group, because groups provide individuals with a sense of security and acceptance. In an exploratory study into female students’ attitudes and behaviors towards binge drinking, Rhiannon Carpenter of the University of Oxford, U.K. et al. (2007) researched the link between alcohol consumption and group behavior at Leeds University. The results suggest that many students perceive drinking as a “social lubricant” that helps them make new acquaintances. As one participant in the study noted: “You are out of your comfort zone. Your friends and family are back home. You will go out more because you have to in order to meet people and then because of that, you end up drinking” (Carpenter et al., 2007). Therefore, it is not difficult to see why alcohol companies often try to include images of social interdependence in their marketing campaigns.

**Limitations:** Perhaps the most obvious limitation to this study was the difficulty of defining “independent” and “interdependent” in order to categorize the advertisements. One method of classification is to evaluate the language and number of people featured in the advertisement, as was done in this study. However, there are cases where the message of the advertisement clearly points in one direction, while the variables used in the criteria place the advertisement in the other category. For example, some tobacco advertisements contained more than one person, but the message contained “self” words, or vice versa. In this study, the language was given priority over the number of people present in the advertisement because the elaboration-likelihood model suggests that when an individual’s motivation to continue engaging in a behavior is high, elaboration of the message that is supporting the behavior is high as well. One form of elaboration could be a stronger focus on message content (words) rather than context (pictures). However, sometimes an advertisement would be ambiguous: no people would be present, or no “self” or “other” words would be found in the message (for example “play hard” with a picture of a car in the background). While it’s possible to assume that cars and the focus on an adventurous spirit would be more closely related to independence, rather than interdependence, such advertisements were discarded.

**Implications:** The advertising campaigns of alcohol and tobacco companies focus heavily on the social aspects of smoking and drinking. Indeed, peer pressure appears to be an especially potent force on pre-teens. Lisa Henriksen of the Stanford Prevention Research Center in California (2008) showed that young people (sixth, seventh and eighth graders) are not only very receptive to alcohol and tobacco advertising, but are also very willing to engage in the consumption of these substances. In addition, she reported that non-drinkers who were found to be highly responsive to alcohol marketing were 77% more likely to initiate drinking by the time of the follow-up than those who were not responsive. Henriksen’s study demonstrates just how effective advertising in these two industries can be. On the other hand, the results of this study can be used by prevention marketing specialists in their effort to educate the public about the health risks associated with alcohol and tobacco. It may be effective for anti-smoking advertisements to contain images that diminish the glamour associated with cigarettes, and for anti-drinking advertisements to contain images of social exclusion. Regardless of its applications, this study identifies specific psychological tools that are found to be effective in tobacco and alcohol advertisements, potentially encouraging future research to focus on analyzing whether these psychological tools are used in other industries as well.

**REFERENCES**


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