

## **CLASS NOTES**

### **HISTORY**

First there were theologians, philosophers, poets, and novelists and then came psychologists. Questions about human behavior, thoughts, and feelings were being asked and answered long before the beginning of the psychology. The ancient Greek philosophers, Plato and Aristotle, were interested in understanding the human mind. They differed about the source of knowledge. Plato claimed that we are born with complete knowledge and only need to access this knowledge. Aristotle argued that we acquire knowledge through experience. These two positions continue to this day in a somewhat different guise as nature versus nurture as determinants of human behavior.

The ancient Greek philosophers explained the personality characteristic, temperament, in terms of the amounts of four humours; blood (enthusiasm), black bile (depression), yellow bile (anger), and phlegm (apathy). This question is still being examined today, but now neurotransmitters and hormones have replaced humours as the basis of temperament. We now rely on the scientific method to find answers to questions that were explored long ago in a very different way.

### **SENSATION & PERCEPTION**

#### **Negative Afterimages**

Each of the two color inputs to a specialized thalamus color cell suppresses the activity of the other color component. When a color input stops, the suppressed component becomes overexcited and yields the experience of that color. For example, for a red-green cell, a green input suppresses the red output. When the green input stops, the cell generates a red output. The same applies to blue-yellow and black-white cells.

### **BRAIN AND BEHAVIOR, THOUGHTS, AND FEELINGS**

#### **Sexual organization of the brain**

Research beginning in the 1950's demonstrated that, in rats, testosterone levels during a specific "critical period" during fetal development can determine the size of a nucleus in the hypothalamus. This sexually dimorphic nucleus (SDN) is typically larger in genetic males than females. Exposure of genetic females to testosterone results in a SDN that is the size of the SDN typically seen in genetic males. Blocking the action of testosterone during the critical period in genetic males leads to a SDN that is typically the size seen in genetic females. These brain alterations are associated, in rats, with masculinization of behavior in females and feminization of behavior in males.

Human males have a larger SDN (INAH3) than females. The size difference in the INAH3, in humans, does not appear until about age four, the same time when gender identity emerges. There have been recent reports of size and activity differences of some brain structures in heterosexual and homosexual men and women. Much more research will be needed to determine if there are functional relationships between sexual orientation, differences in size, and other characteristics of various brain structures (Swaab, D. F, Hofman, M. A., Trends in Neuroscience 18, 264-270, 1995), D.F. Swaab, Proceedings of the National Academy of Sciences, 105, 10273-10274, 2008), Savic, I Linstrom, P (2008) Proc Natl Acad Sci USA 105:9403-9408.

Recent findings support the view that prenatal conditions, of some kind, contribute to the determination of sexual orientation in adult human males. Later born male siblings have a higher probability of exhibiting homosexuality than earlier born siblings. This correlation was not found in families with adopted male siblings . This indicates that the social family environment was not a factor in the birth order findings related to homosexuality (Bogaert, A. F. Proc. National Academy of Sciences, 103, 10771-10774, 2006). Human females that were exposed to unusually high levels of testosterone during fetal development are related to masculinization of behavior, but not sexual orientation (Hart, K, Child Development, 2002). Recent findings indicate that the level of testosterone in amniotic fluid predicts the level of male-typical play behavior in both male and female children (Auyeung et. al. Psychological Science, 2009).

### **Intracranial Reward**

In 1950, James Olds accidentally discovered brain areas involved in reward processes. The most important area involves cells in the lateral hypothalamus and fiber systems extending from the midbrain to areas anterior areas of the brain. Subsequent research has indicated that the neurotransmitter dopamine is an important neurotransmitter involved in these systems. The earlier research of Olds has led to the discovery that there are different systems involved in “wanting” and “liking”. This finding has important implications for understanding substance abuse. In long term drug addicts there is a strong wanting but diminished liking of an addictive drug, (The Journal of Neuroscience, 2007, 27, 7, 1594-1605).

### **Food Intake Regulation**

There are several nuclei in the hypothalamus that have been implicated in food intake. One of these nuclei, the ventromedial hypothalamic nucleus (VMH) plays a particularly important role in food intake and body weight regulation by controlling meal duration and time of eating. When this structure is damaged, meal duration becomes longer and eating occurs throughout the 24 hour day. This results in increased caloric intake and increased body weight.

Recent findings have identified two hormones, leptin and ghrelin, and a neuropeptide, NPY, that act on hypothalamic nuclei to influence food intake. Leptin inhibits food intake and NPY and ghrelin stimulate food intake.

## **The Hypothalamus and Stress-induced Suppression of the Immune System**

The hypothalamus can produce a suppression of the immune system in three different ways. 1. The hypothalamus can stimulate the anterior pituitary gland to stimulate the adrenal cortex to release cortisol. High levels of cortisol can suppress the immune system. 2. The hypothalamus, via the sympathetic nervous system, can stimulate the adrenal medulla to release adrenalin and noradrenalin. High levels of adrenalin and noradrenalin can suppress the immune system. 3. The hypothalamus, via the sympathetic nervous system, can directly suppress lymphocyte activity in the lymph nodes which results in a diminished immune response.

For more details on the effects of stress on health see the section Stress and Health below.

## **The Hippocampus and Amygdala**

The hippocampus is involved in the consolidation of memories or engrams as permanent traces. Damage to the hippocampus interferes with converting short-term temporary memories into permanent memories. H.M. is a well known example of the consequences of damage to the hippocampus. The hippocampus is also involved in response inhibition processes. Finally, recent findings suggest that the cell count in the hippocampus can vary from time to time and low cell counts are correlated with clinical depression, It may be that stress-related elevations in cortisol from the adrenal cortex may induce cell loss in the hippocampus that may actually be a cause of some clinical depression. *J. Neuroscience* 27, 2734-2743, 2007.

The amygdala plays an important role in fear and anxiety. This structure appears essential for the establishment and recall of memories for negative experiences. Also, the amygdala appears important for recognition of emotional signs of fear in facial expressions.

Psychopaths have an impaired ability to experience fear that may be related to abnormal functioning of the amygdala.

See below for more details about the amygdala and memories involving fear related experiences.

## **Pruning**

There is an ongoing process of cell loss in the brain that is most evident from about age 12 to 20 years. This is a normal and adaptive process that eliminates unnecessary connections. Pruning, when too little, can result in brain nuclei that are unusually large. This may account for the larger amygdala seen in autistic children around age 6. Excessive pruning is seen in the excessive cortical cell loss of adolescents who begin showing signs of schizophrenia.

## **Mirror Neurons**

Mirror neurons are activated during the observation of a behavior or display of a behavior. For example, monkeys observing another monkey performing a movement, display activity in a subset of cortical neurons that are also active when the observer monkey engages in the same behavior. These neurons may play an important role in observational learning.

The ability to understand the feelings of others may also depend upon mirror neurons that are excited when an individual experiences an emotion or observes another individual displaying the same emotion as evident in facial expressions etc. Recent research indicates that autistic individuals may have impaired mirror neuron function. For more information see Marco Iacobini, "Mental Mirrors" *Natural History*, 2008 and Sandra Blakeslee, "Cells that read minds" *New York Times*, 1/10,2006.

## **MEMORY**

### **State Dependent Memory**

Sensory feedback from various physiological systems can serve as contextual cues for retrieval in the same way as do external environmental cues. When internal cues generated by drug and hormonal influences are present during learning, the absence of these cues can compromise recall at a later time. For example, recall while drugged or not drugged is better when the individual is in the same biochemical state as during learning.

### **The Amygdala and Fear-related Memory**

The amygdala appears to be essential for memory of fear-related events as well as recognition of fear in the facial expressions of others and the facial expression of fear.

The drug, propranolol, that blocks the action of noradrenaline in the amygdala can impair the recall of negative emotional events, but not neutral or positive emotional events. With stories that contain negative, positive and emotionally neutral material, propranolol, selectively impairs recall of the negative content. Recently, a drug that suppresses the action of the hormone cortisol has been reported to suppress the recall of negative memories.

### **False Memories**

A technology is emerging that allows detection of false and real memories. Recent studies have reported different brain wave patterns for real and false memories. Subjects were given a list of words and asked later to recognize, which words had been previously seen. When subjects incorrectly identified a word as part of a previously learned list, the brain wave pattern was different than for previously learned words from the list. Similar results have been reported using brain scan technology. (Sederberg et. al. Gamma oscillations distinguish true from false memories, *Psychological Science*, 18, 2007, 927-932.

## **Automatic memory**

Encoding some types of information requires no conscious effort. For example, information related to location, frequency, or duration of events or objects is remembered equally well with or without instructions to do so.

## **LANGUAGE**

There are various types of evidence that suggest that there is a “hardwired” system for acquiring early language skills. Language stages occur in the same sequence in all children in all cultures at the same points in time. Babbling occurs in both hearing (vocal) and non-hearing children (manual gestures). Deaf children develop their own signing in the absence of signing caretakers. Six-month old infants ignore minor variations in the different sounds in their own language, but notice similar variations in the sounds that are unique to another language.

There has been interest in the language capacities of animals. Other than parrots, other species cannot make language sounds. This was painfully evident in the studies of the home-reared chimpanzee, Gua. Washoe learned ASL signing. Kanzi learned ASL from observing her mother. Both Kanzi and Koko have displayed simple creative uses of ASL signing. The evidence seems quite clear that chimpanzees and gorillas are capable of simple language. Dr. Irene Pepperberg’s parrot, Alex has displayed a remarkable vocabulary and simple counting and grouping skills

## **DEVELOPMENTAL**

Low correlations between early childhood experience and behavior and adult measures of personality have encouraged psychologists to accept the possibility that other periods in development are more influential than childhood in determining adult personality characteristics. All developmental psychologists agree that genetics play an important role in adult personality. Judith Harris believes that socialization influences of adolescent peer groups are the other major personality influence (*The Nurture Assumption*, Free Press, 2000). Michael Lewis believes that adult personality characteristics are strongly influenced by the current social context of the adult. Both Harris and Lewis minimize the influence of childhood experiences as an influence on adult personality characteristics. It may well be that while genetics are a strong influence, childhood, adolescent group socialization, and adult social contexts will also influence personality but to a different degree for different individuals.

While some findings suggest that the typical range and variety of childhood experiences may not be as influential in shaping adult personality as previously thought, it is also clear that severely limited social and intellectual stimulation, during early development, can have measurable negative effects on intellectual abilities and social skills. Studies of Romanian orphans indicate that impoverished intellectual and social stimulation can result in cognitive impairments and difficulties in establishing close, intimate social relationships. These negative effects were observed in some but not all of these

orphans, after adoption (Rutter, M. L. et. al., British Journal of Psychiatry, 2001, 179, 97-103; Rutter, M.L. et. al., Developmental Psychology, 2004, 40, 1, 81-94).

Recent research indicates that organizational changes in the brain continue after birth until a least the close of adolescence. "Pruning" of cortical neurons progresses from the rear of the brain to the frontal cortex from about age 12 to age 18. These changes may account for the impulsivity and risk taking that is characteristic of the adolescent. (Neuroscience 14,3, 2007, 961-968, Current Directions in Psychological Science, 2007, 16, 2, 55-59). Risk taking in adolescents does not appear, as commonly believed, to be due to underestimation of risk, as compared to adults, but to an inability to inhibit behavior and overestimation of benefits of particular behaviors, Scientific American Mind, December 06/January 07, pages 59-65., Steinberg, L. Current Directions in Psychological Science, 2007, 16, 2, and Reyna, V . F. and Farley, F. Psychological Science in the Public Interest, 7, 1, 2006. 55-59.

## **STRESS & HEALTH**

Stressors are stimuli that induce a state called stress that is defined in terms of physiological changes including increased inflammatory activity, heightened activity of the sympathetic nervous system, elevation of cortisol from the adrenal cortex, and adrenalin and noradrenaline from the adrenal medulla. Elevation of the adrenal hormones can suppress lymphocyte activity related to the immune response and sympathetic nervous system output directly to the lymph nodes can also suppress lymphocyte activity. Some individuals have unusually strong sympathetic nervous system response to stressors which can make them particularly vulnerable to stress-related suppression of the immune system.

Stressors of brief duration induce physiological changes that facilitate coping with infection and other consequences of injuries. However, long duration stressors induce changes in lymphocyte activity in that can compromise the immune system's ability to cope with disease. In addition, long term stressors can result in inflammatory conditions that can also compromise health.

The ability of a stimulus to induce stress depends upon an individual's appraisal of a stimulus. Research has shown that parents of terminally ill children will have episodes of denial of the severity of the illness and these episodes are accompanied by a reduction in physiological activity associated with stressors. Similarly, Vietnam War medivac pilots had different perceptions of the risk of medivac flights as compared to crew members and had below normal levels of adrenal hormones usually associated with stressors. Crew members had elevated levels of adrenal hormones and viewed the missions as much more dangerous as compared to the medivac pilots.

Frankenhauser has reported that physiological adrenal hormone responses to cognitive stress, while initially higher in males as compared to females, were matched, decades later by females in the same task. She interpreted her findings as reflection of a change in the attitudes regarding task performance and failure in females.

## **MOTIVATION**

Research has identified different neuronal populations related to detection of physiological need for food, search behavior for food, recognition of food, and finally ingestion of food. The neurons for each function were located in the hypothalamus except for neurons related to ingestion which were located in the brain stem. This type of organization will probably be found for other types of drive states.

With regard to sexual motivation, research has found that the strength of the correlation between sex hormone level and sexual motivation varies with species. In general, males are less dependent upon sex hormones for sexual motivation than females and more complex-brain species are less dependent upon sex hormones for sexual motivation as compared to more simple-brain species.

## **SLEEP**

Recent research has found that processing of the engram occurs during sleep and that such processing improves retrieval. (R. Stickgold & J. Ellenbogen, Scientific American, August 7, 2008) Sleep deprivation, particularly REM sleep, interferes with retrieval of learned material. Sleep deprivation also increases the probability of work-related driving accidents. There is no scientific evidence that indicates that learning can take place during sleep. REM sleep dreams are typically more emotional and vivid than dreams occurring during NREM sleep. Dream content typically reflects events of the day of the dream or events that occurred a week earlier. Much of dream content involves negative emotions, usually anxiety. As little as 24 hours of sleep deprivation can result in lapses in cognitive function, perception, and arousal (Chee, Michael W. et al. The Journal of Neuroscience, May 2008, 28, 5519-5528).

## **ABNORMAL BEHAVIOR**

Schizophrenics are sometimes troubled by an attentional gating disorder that impairs their ability to filter out irrelevant stimuli.

Early-onset schizophrenia, around age 14, is associated with progressive loss of cortical gray matter. This may reflect excessive "pruning" which is the natural loss of cells that occurs as a part of organizational brain changes that continue until adulthood.

Recent studies have indicated that schizophrenia is associated with elevated dopamine activity, dopamine levels, and diminished glutamate activity. In laboratory studies, normal subjects given the drug, methamphetamine, that elevates dopamine activity, display symptoms of schizophrenia and a drug that lowers glutamate activity, ketamine, also results in symptoms of schizophrenia.

"The elusiveness of schizophrenia, new clues to treatment" Benedict Carey, New York Times, June, 13, 2008. Schizophrenia: More dopamine, more D2 receptors, Seeman, P. and Kapur, S., Proceedings of the National Academy of Sciences, July 5, 2000, 97, 7673-7675.

## MOOD DISORDERS

Some cases of clinical depression may be associated with a decrease in cell number in the hippocampus induced by stress-related elevations in cortisol. In laboratory animals, antidepressants are associated with elevations in hippocampus cells

The bipolar disorder appears to be associated with elevated levels of glutamate during mania and depressed levels of glutamate during depressive episodes. Recent research suggests the possibility of involvement of dopamine and serotonin in this disorder, in addition to glutamate. Lithium is a commonly prescribed medication for symptomatic treatment of the bipolar disorder.

Treatment for depression associated with the unipolar disorder involves one or more of the treatments below.

Selective serotonin reuptake inhibitors (SSRI) increase serotonin activity by slowing reuptake

Monoamine oxidase inhibitors increase noradrenaline, and serotonin activity by slowing metabolic breakdown in the synapse

Tricyclics and SSRIs that elevate levels of serotonin and noradrenaline activity by slowing reuptake.

Bupropion(Wellbutrin) increases dopamine and noradrenalin activity by slowing reuptake.

Electroconvulsive shock therapy. This therapy while controversial, has gained support from recent meta-analysis based study of treatment outcomes.

1. Pagnin D, de Queiroz V, Pini S, Cassano GB (2004) *Efficacy of ECT in depression: A meta-analytic review. J ECT 20:13–20.*
2. [Eri Segi-Nishida](#), [Jennifer L. Warner-Schmidt](#), and [Ronald S. Duman\\*](#) PNAS, 12. 2008, 105, 32, 11352-11357.

Cognitive therapy

Star-D research project

Findings from the Star-D research project indicate that for depressed individuals who do not show a positive response to an initial antidepressant, trying a higher dosage, or changing to another class of antidepressants or, cognitive therapy can result in almost 70 % of depressed individuals eventually showing a positive response to one of the above treatments. *Current Psychiatry Reports*, 2007, 9, 6, 449-459.

## **PSYCHOPATH/ANTISOCIAL PERSONALITY/ SOCIOPATH**

The terms psychopath, antisocial personality, and sociopath are by used by some mental health professionals to refer to the any disorder that involves antisocial behavior. Other mental health professionals such as psychologist Robert Hare reserve the term psychopath for individuals who display antisocial behavior and, in addition, are manipulative, charming, and experience little or no fear or guilt. Some psychopaths may also display aggressiveness and or impulsivity(Snakes in Suits, Paul Babiak & Robert Hare, Harper Collins, 2007). There is some evidence that the psychopath's impaired ability to experience fear may be related to abnormal amygdala functioning. According to Hare, the term sociopath refers to an individual who abides by the rules and moral codes of a subgroup that does not conform to the moral codes and rules of the larger community. The term antisocial personality disorder refers to individuals who break societal rules due to lack of control. In some cases, these individuals feel guilt after breaking rules that they accept and try, unsuccessfully, to obey.

## **AUTISM**

Autism is characterized by motor control problems, repetitive behaviors, impaired expression and comprehension of emotional states, and impaired communication. The prefrontal cortex, cerebellum, and amygdala are unusual in size and or function in individuals with this disorder.

Autistic individuals appear to have impaired "mirror neuron" function that may interfere with observational learning of behaviors and understanding of emotional states in others (Oberman, L.M. & Ramachandran, V. S., Psychological Bulletin 2007, 133, 2, 310-327).

The promise of "facilitated communication" therapy did not materialize and current therapies emphasize behavior modification techniques that may compensate, to some degree, for the lack of learning behaviors via observational learning.

Recent findings indicate that a commonly used intelligence test, the Wechsler, underestimates the intelligence of autistic children. The Raven test, that requires less social interaction during testing, yields higher IQ scores than the Wechsler. Dawson, M.; Soulieres, I; Gernsbacher, M; and M, Laurent: Psychological Science, 18, 8, 2007, 657-662.

The forthcoming revision of the Diagnostic and Statistic Manual, DSM V, will eliminate the category Aperger's Syndrome and include this symptom complex in the category Autism Spectrum Disorder.

## **Psychosurgery**

The frontal lobotomy was developed by Egas Moniz in 1936. The procedure involved disconnection of fibers connecting the frontal lobes to the rest of the brain. The procedure was introduced in the United States by Walter Freeman. Over 50,000 patients received the procedure from 1936 until the mid 1950's. The typical outcome was diminished motivation, inability to plan, occasional impulsivity and a more manageable patient.

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