EVOLUTIONARY ORIGINS OF OBSESSIVE-COMPULSIVE DISORDER AND DEPRESSION

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TABLE OF CONTENTS

Chapter
I.  Introduction .................................................................1

II.  A Style in the Evolutionary Study of Human Behavior........4

III. Overview of Obsessive-Compulsive Disorder.................14

IV.  Evolutionary Explanations of Obsessive-Compulsive Disorder…25

V.   Overview of Depression..................................................41

VI.  Evolutionary Explanations of Depression .........................47

VII. Linking Evolutionary Explanations of Mental Illness to Attachment Theory………………………………59

VIII. Conclusion.................................................................72

BIBLIOGRAPHY.................................................................75
Chapter I

Introduction

Laura Betzig, a sociobiologist, stated quite matter-of-factly that “people are animals.” Much earlier, Harry S. Truman commented, “[T]he human animal and his emotions change not from age to age.” These quotations reveal something about the research I have conducted for my thesis: humans are affected by the same evolutionary processes as any other animal, these processes affect their everyday lives, including their emotions, and such processes have been the same throughout human history.

The human animal is an evolved social organism. As biological entities, humans must transmit their genes to the next generation. This in itself is the ultimate cause of human social behavior (Stevens & Price 2000). For transmission to occur, people must successfully reproduce within a particular environment during their present life history situation at the expense of other reproducing conspecifics, sometimes even at the expense of long-term survival. Since relatives share a proportion of one’s genes, promoting their survival and reproduction is important as well. As a result, any behavior that has inclusive fitness benefits for the individual may be favored by natural selection (Stevens and Price 2000).

While evolution by natural selection has long been a foundation of biomedical science, it has recently gained new power to explain many aspects of disease (Nesse 1991). This progress results largely from the disciplined application of what has been
called the adaptationist program. Of particular importance to this thesis are behaviors produced by two “diseases” of the mind, obsessive-compulsive disorder (OCD) and depression (unipolar), both which have adaptive functions that give fitness benefits for the carrier.

Although humans are the subject of this thesis, nonhuman animal models will help illustrate behavioral traits associated with OCD and depression. According to Croft (1979), animals display emotions, or feelings, with human qualities to them, but in a much more simplified form. For example, infant rhesus monkeys separated from their mothers immediately following birth show atypical behavior during preadolescence and adolescence (Harlow & Harlow 1962). However, it must be remembered that the same behaviors in two or more different species may be produced by different cognitive systems, and the phylogenetic origins of these same behaviors may be different (Boyer & Lienard 2006).

Maternally deprived monkeys can develop compulsive habits, such as pinching the same area of skin several times a day, and seem to display anxiety and low mood, or a depressive-like state (Harlow & Harlow 1962). Breaking maternal-offspring affectional bonds at an early developmental state may result in emotional distress in humans as well (Bowlby 1979). I will review how attachment theory explains certain elements of religion and romantic love in relation OCD and depression.

The objective of this thesis is to review hypotheses put forward to explain the functional significance of OCD and depression using mainly neo-Darwinian principles. For this paper, OCD and depression are themselves “innate dispositions” that promote
adherence to evolutionarily stable strategies (ESS), not dysfunctions in these “innate dispositions,” as stated by Wenegrat (1990). These dispositions are genetically based. Some individuals believe that OCD and depression are not in themselves adaptive. Instead, they are considered dysfunctions or dysregulation of adaptive systems, thus making them maladaptive (disease processes). This perspective could be a sort of null hypothesis.

Since sociobiology is not universally accepted (yet!), and evolutionary psychobiology is only in its infancy (Nesse 1991), hopefully this thesis may act as a very brief introduction to these disciplines.
Chapter II

A Style in the Evolutionary Study of Human Behavior

Human Behavioral Ecology (HBE) is one approach used to study human behavior (Smith 2000). Two other styles are sometimes recognized: evolutionary psychology (EP) and dual-inheritance theory (DIT); however, all of them propose ways of explaining sociobiological phenomena in humans (Smith 2000). I believe depression and OCD are best explained with HBE, not EP.

EP claims that human behavior is guided by domain-specific or special purpose cognitive modules that were mostly formed in the so called environment of evolutionary adaptiveness (EEA), which, to be fair, is not necessarily the specific geological period known as the Pleistocene, but rather a general name of a recent human environment called the “Pleistocene” based on statistical calculations (Tooby & Cosmides 1990). If current social and natural environments are different from this past environment, than certain modern behavioral dispositions may be maladaptive (Smith 2000).

HBE proposes that human behavior can respond adaptively to rapid changes in the current environment, thus preventing “adaptive lag” (Smith 2000). Some researchers believe many mental conditions are simply maladaptive responses to new environmental conditions. Based on the behavioral ecologists’ application of phenotypic plasticity, I do not think this is the case for depression or obsessive-compulsive disorder. The
substantial emphasis on cultural inheritance via memes by practitioners of DIT (Smith 2000) might make this approach hard to apply to the evolution of psychopathology.

There are other key concepts used by human sociobiologists (or HBE). One being that natural and sexual selection are the only evolutionary processes resulting in adaptive behavior in a particular situation, with the gene of the individual as the unit of selection (Cartwright 2000). Genetic drift and other forces are not generally used by sociobiologists (Cartwright 2000). As mentioned earlier, a critical assumption of HBE is that behavioral differences among populations result from “environmentally induced variations in the expression of basically the same genotype” (Irons 1979). An ability to produce different behavioral regimes from the same genotype is called “phenotypic plasticity,” and is itself an adaptation (Irons 1979). There are two main types of phenotypic plasticity: the reaction norm, a continuous range of potential phenotypes from the same genotype; or a polyphenism, an “either/or” choice of phenotypes from the same genotype (Gilbert 2006). An example of “phenotypic plasticity” is the different adaptive immunological responses elicited by infectious predators (Gilbert 2006).

The foundation of HBE research is based upon this aptly named “adaptationist program.” According to Mayr (1983), “the adaptationist program attempts to determine what selective advantages have contributed to the shaping of the phenotype.” Many definitions of adaptation are available, and most human sociobiologists distinguish between “adaptiveness” and adaptation (Cartwright 2000). “Adaptiveness” (to different environments) is used mainly by human behavioral ecologists to describe the human tendency to maximize reproductive opportunities based on circumstances in the
immediate environment, while adaptations are specific traits acquired by gradual accumulation of past selection pressures (Cartwright 2000).

Over the years the “adaptationist program” has been criticized, especially by Gould and Lewontin (1979) in their frequently cited paper, “The Spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme.” Gould and Lewontin (1979) claim that some scientists overused the concept of adaptations, formed via natural selection, as an explanation for phenotypic phenomena, while neglecting other evolutionary mechanisms, or simply not considering the possibility that some structures may not have been selected at all, but rather co-opted for a different purposes from its original form or function (exaptations) (Gould & Lewonin 1979). In other words, some features may be incidental, not actual adaptation. They likened them to the spandrels of some vaulted structure, like the Arch of Trajan.

There is no doubt the “adaptationist program” has been misused in the past. However, a few misapplications of adaptationism do not reflect the discipline of sociobiology as a whole nor the methodologies used by practitioners of HBE. As Brown (1982) points out, human sociobiologists research ongoing evolutionary processes in natural populations, the small scale stuff, which requires a different use of the comparative method from that of paleontologists, who tend to work on deep time in higher taxa, the large scale stuff.

All disciplines have examples of poor research, but these generally are not used to discredit the whole field. Furthermore, the foundation of human sociobiology was only established in 1975 by E.O. Wilson in his book, *Sociobiology: The New Synthesis*, specifically in the very last chapter, Chapter 27. Many research directions taken in HBE
are in their infancy. Though some of the specific genes and gene complexes for specific behaviors are unknown, one should keep in mind that black holes were mainly mathematical abstractions before they were observed in space.

Numerous other aspects of theory and method used in human behavioral ecology could be considered here. I will address some of these issues, keeping in mind those important to evolutionary psychobiology. Two general views of human behavior as a product of evolutionary biological theory are: the “strong sociobiological thesis”, a more biologically driven view of behavior based on the genetic variation in populations sans the environment, and the “weak sociobiological thesis” (Cronk 1991). The “weak” form is the most common view among human sociobiologists. An essentially similar human genotype is assumed to exist that endows people with physical and mental predispositions and abilities capable of producing adaptive behavior in individual social and biological situations (Cronk 1991). Behavioral plasticity is part of this endowment.

Since the “weak sociobiological thesis” is taken in the current review, a jaunt through the schizophrenic worlds of culture may be useful. A simple definition of culture does not exist (or at least would not be acceptable if it did). Assuming culture is unimportant in sociobiological research prevents uninitiated anthropologists from getting a clear picture of the field. Though there may be some genetic determinists in HBE, most practitioners consider culture in their research since it is itself a product of biology.

However, I think biology will always trump culture when “push comes to shove.” I do not mean that culture will never influence human behavior. According to “selective retention” theories, the material, ecologic, and other aspects of culture (“cultural
variants”) are “selectively retained or discarded” by an individual’s preferences which themselves are determined by innate dispositions (genetic) (Wenegrat 1990). In other words, one’s biology determines what aspects of the culture will become part of a region’s cultural heritage.

Lumsden and Wilson (1981) describe what they called “epigenetic rules” that affect the probability a particular culturgen (e.g. myths, ideas, material artifacts) will become part of the cultural tradition of a particular society. Thus, the genes direct cultural evolution through these “epigenetic rules,” making culture itself a reflection of biological needs.

Although this thesis is a literature review of evolutionary explanations for two specific psychopathologies, I would still like to address some methodologies used by human behavioral ecologists. The study of complex human behaviors relies on two main types of models: optimization models and game theoretical models (Cronk 1991).

Optimization models involve usually one player placed in a simulated environment with a set of biological and nonbiological constraints along with a range of different behavioral choices (Cronk 1991). Success and failures are measured in “currency”, or reproductive output (Cronk 1991).

A “universal” human strategy, one used in similar circumstances in every society, does not in itself prove that a strategy is “biologically determined” (Wenegrat 1990). In other words, culture is not necessarily insignificant. However, this paper considers only “innately probable strategies,” or those that result from combinations of gene activity (Wenegrat 1990). An Evolutionary stable strategy (ESS) is a phenotype possessed by all
individuals in a population, or enough people to exceed a certain critical number, no mutant alternatives of the strategy can replace that strategy, and any people without that alternative will be displaced (Griffiths 2008). In other words, there is no “better” strategy than the ESS (Griffiths 2008). A universal ESS is considered an “innately probable strategy” (Wenegrat 1990).

There are some aspects of ESSs relating to OCD and depression. An ESS will be fixed in the gene pool by selective forces against alternative strategies (Wenegrat 1990). An ESS is always a social strategy and affects both kin and nonkin in a population (Wenegrat 1990). As part of an evolutionary stable strategy, humans must perform social analyses in their environment. One must know who is reliable or who will cheat or not reciprocate in some exchange (Wenegrat 1990). They must know where they stand in relation to others in a rank hierarchy (Wenegrat 1990). The depth of kin relations and the number of nonkin in a group is necessary knowledge for social interaction (Wenegrat 1990). They must also have a developed “theory of mind” to surmise the intentions of multiple players involved in a particular social exchange. Of course, all of this requires an awareness of the cultural mores within the social exchange network (Wenegrat 1990).

Some EESs are mutualism, reciprocal altruism, kin altruism, male versus female reproductive strategies, and attachment bonds (or systems), like those formed between mother and infant (Wenegrat 1990). Ultimately, these strategies should lead to inclusive fitness benefits for the individual using them and severe costs to those who do not (Wenegrat 1990). Evolutionary stability does not mean that all members of a population must use that strategy (Wenegrat 1990).
Humans have “innate dispositions” that promote adherence to these ESSs (Wenegrat 1990). For example, males have increased sexual arousal behaviors that help males compete for female mates (Wenegrat 1990). According to Wenegrat (1990), mental diseases are basically dysfunctions of the innate dispositions that normally promote adherence to an ESS. The evolutionary explanations reviewed here should show that what are called mental diseases do actually promote ESSs. For example, as discussed later, clinical depression promotes mutualism among people affected by an individual with clinical depression.

From an evolutionary perspective, lifetimes are about engaging in activities that enhance reproductive success in one’s environment (Cronk 1991). Life history theory identifies two categories for such activities: somatic effort and reproductive effort (Hewlett et al. 2000). Somatic effort refers to action taken to assure physical survival, such as keeping healthy, obtaining shelter, avoiding predators, or any behavior to assure one’s safety in a specific environment (Hewlett et al. 2000).

Reproductive effort should ensure that an individual’s genes are represented successfully in future generations by focusing on three main activities: parenting effort, mating effort, and nepotistic effort (helping relatives depending on the probability a particular relative shares the same gene, a gene for kin altruism) (Hewlett et al. 2000). However, allotting resources to reproductive or somatic efforts requires careful planning because resources used for one purpose cannot be used for another important purpose (Hewlett et al. 2000).
Studies of human somatic effort primarily concern foraging behavior, resource acquisition and distribution (Cronk 1991). The study of foraging strategies is concerned with a family of models under the heading of optimal foraging theory, which addresses aspects of forager decision-making: diet breadth, prey choice, patch choice, habitat choice, foraging time, and group size or choice of foraging mates (Cronk 1991). Depression and OCD may have evolved, or originated, in a past environment where these decisions were a matter of life or death. However, in modern environments, such as those of industrialized nations, individuals can still benefit from these adaptations, as discussed later. In addition, depression and OCD have been documented in contemporary non-industrialized societies. According to Cronk (1991), a similar approach to studying somatic effort can be applied to other modes of resource acquisition, such as horticulture and pastoralism.

Foraging models concerned with “risk analysis” are particularly important for understanding pathology (Sugiyama & Chacon 2000). Pathology risks, specifically psychopathologies, associated with depression and obsessive-compulsive disorder may actually have an adaptive function in an individual’s social network. As will be seen later, the low mood and lack of motivation characteristic of clinical depression may be part of a bargaining strategy to obtain resources or help from kin or nonkin in an individual’s social environment (Hagen 2003).

The other aspect of somatic effort, resource distribution, includes sharing, reciprocity, and trade (Cronk 1991). I would also like to add to this list the use of a commitment to act in some future situation without expecting some immediate return, a more selfless act
Healthy foragers are less likely to make an investment with a sick or disabled forager, especially one with little chance of survival; thus, pathology risk makes forming reciprocal relationships more formidable task (Sugiyama & Chacon 2000). Thus, in the case of the social navigation hypothesis, the depressed person most likely has an important function in the group (Cline-Brown & Watson 2006).

Within a lifetime, some behavioral adaptations function in early life events, while others function late in life. For example, the attachment behavioral system changes in a single lifetime from an infant-caregiver relationship to an adult romantic love relationship, which involves a sexual mating system not seen in the infant-caregiver attachment bond (Hazan et al. 2006). Mating effort is one aspect of reproductive effort (Cronk 1991). Mating systems are produced by interactions between female and male strategies (Cronk 1991). Of course, mating decisions are also influenced by other members in an individual’s social network, like the father of the bride (Cronk 1991). Females may choose a mate based on the resources they control or how successfully they can acquire resources (Cronk 1991).

High ranking males usually have access to more resources than lower ranking males. The outcome of alpha rank is usually greater reproductive success (Cronk 1991). Parental investment is another form of direct reproduction. According to attachment theory, maternal insensitivity can lead to an avoidant attachment style in children (Bowlby 1969; Main 1999). This type of attachment style in childhood may affect the success of romantic love relationships (Hazan & Shaver 1987; Main 1999).
One more aspect of culture evolution should be noted. Wenegrat (1990) states that culture “must be rather conservative in the face of innate dispositions.” For example, evolutionarily stable strategies would be of little importance if the innate dispositions that promoted them were easily manipulated by the fast pace of cultural change or “at a moment’s notice.” I did not choose a particular theory of cultural evolution because it is not important for this brief review of Darwinian approaches to mental conditions. Culture, in my opinion, will not change the ultimate function of OCD and depression.
Chapter III

Overview of Obsessive-Compulsive Disorder

A 32-year old pregnant woman sought outpatient treatment three months before her second child was born. She complained of several magical rituals regarding numbers, and noted that certain items of clothing and other activities had become connected in her mind to the devil. In addition, she increasingly checked faucets, light switches, and buttons on her children’s clothes. This individual’s fears focused mainly on the possibility that bad luck would happen to her loved ones, especially her children, unless she intervened. To manage her fears, she performed a variety of repeating, undoing, and checking rituals. For example, if a bad thought about the devil occurred while dressing, she took off her cloths and started over again. Moreover, if she were prevented from doing a ritual, she would feel anxious (Barlow 2002).

The 32-year old woman mentioned above experienced what has been called demonic possession, religious melancholy, scrupulosity, psychasthenia, compulsion neurosis, and more recently obsessive-compulsive disorder (OCD) (Pitman 1994). Obsession is defined in this paper as any recurrent, intrusive thought, image, or urge that is unwanted but can not be controlled (Turner et al. 2001). Compulsions will be defined as any purposeful, repetitive behavior or mental activity that is performed in a ritualistic or stereotypical way, generally with the goal of reducing anxiety associated with an obsession (Turner et al. 2001). The terms obsessions, compulsions, and rituals are
discussed thoroughly later in “Chapter III.” This chapter explores the biological, clinical, and historical aspects of OCD as a type of anxiety disorder (Turner et al. 2001).

The purpose of a historical review is to show that OCD (mental conditions) has been a part of humankind well before the twentieth century, and has interested people from various times and places. It will only highlight the early historical records of OCD. A history of obsessive-compulsive disorder could start at the beginning of humankind (Yaryura-Tobias & Neziroglu 1983). Primativism, the Middle Ages, and contemporary age describe the links among magic, religion, and psychiatry. For example, the use of ceremonies may be explained as a means of placating the anxiety and fear provoked by the presence of unexplainable natural phenomena (Yaryura-Tobias & Neziroglu 1983). Ceremonies and rituals are performed to emphasize rules of hygiene or purification, like hand washing ceremonies during Catholic Mass.

A classic example linking modern and old concepts of obsession can be found in treaties on demonology (Yaryura-Tobias & Neziroglu 1983). An obsessed individual was defined as a person tormented by the Devil. The descriptions of demon-possessed individuals, whose behaviors were characterized by repetitive cursing, yelling, trembling, and involuntary movements, may suggest some of the symptoms seen in today’s obsessive-compulsive patients (Yaryura-Tobias & Neziroglu 1983). For example, in 1486, a boy was described who thrust his tongue out when he passed by a church and was attacked by the Devil as he prayed (Pitman 1994). This description was taken from the Malleus Maleficarum, a 15th century compendium of psychopathology and witchcraft.
Other examples of psychopathology can be found in the New Testament and works by Oesterrich (Yaryura-Tobias & Neziroglu 1983; Pitman 1994).

An early scholar of psychopathology, Bishop John Moore, described in 1692 the uncontrollable “blasphemous thoughts” of some parishioners (Pitman 1994). In 1658, Flecknoe captured what was later called “mania of deliberation” in which the individual can not make quick decisions and “deliberates on all matters” (Pitman 1994). Jeremy Taylor, Bishop of Down and Connor, describes in 1660 what he calls “scruples,” or small, sharp stones. It was intended as a metaphor for the inherent conflict that plagues individuals with obsessions (Pitman 1994). David Hartley, who wrote the Doctrine of Vibrations, in 1749, and Samuel Johnson, in 1759, recognized the relationship between obsessions and compulsions (Pitman 1994).

Near the end of the nineteenth century and beginning of the twentieth century, the school of Mechanism ascended over that of Vitalism (Zohar et al. 1991). While Vitalism held that there exists in living organisms a vital force that is distinct from physical forces, Mechanism states there are no vital principles or forces other than the typical chemical-physical forces of the body (Zohar et al. 1991). One practitioner of Mechanism was Sigmund Freud. Freud hypothesized that the predisposition of obsessional neurosis resulted from a preponderant “sadistic-anal-erotic sexual organization”. He was convinced that guilt was not only a major cause of obsessiveness but that guilt had to do with sex (Dolnick 1998). The Rat Man (Ernst Lanzer) is a case in point.

Lanzer was plagued by obsessive thoughts of a gruesome torture: a criminal was tied up while rats bore through his rectum (Dolnick 1998). As a boy, Ernst Lanzer said he
was punished for biting, similar to the sharp-toothed rat, according to Freud. Thus, stated Freud, the rats symbolized the patient, and the disease transmitting rats symbolized a “disease-transmitting penis” (Dolnick 1998). Freud later hypothesized that obsessive-compulsive adults had been the victim of harsh toilet training. The infant’s fear of losing control of his bowels had become the adult’s fear of losing control of anything (Dolnick 1998). Sigmund Freud’s psychoanalytic view of OCD prevailed through the 1950s.

OCD is characterized by repetitive, stereotyped behavior (obsession) or mental events which do not in themselves provide pleasure, but may be an attempt to prevent some feared event or situation. These mental events could simply function to reduce stress caused by an obsession (Turbott 1997). Some characteristics include: checking rituals, excessive hand washing (up to one hundred times a day), images of harm (e.g., thoughts of a family member being tortured), constant fear of contamination or disease (e.g., ideas that dirt is always on one’s hand), inappropriate or unacceptable behavior (e.g., thoughts or acts of violence in sex), extreme doubts about safety and memory (e.g., ideas that objects are not arranged properly), and reoccurring fear of failure (e.g., thoughts of being terminated from a job because one is not perfect) (Barlow 2002).

These specific examples vary from individual to individual depending on the immediate environment, such as household and family, and one’s cultural environment (Hammer and Zubin 1968). Most individuals with OCD recognize their behavior as excessive, although this may not be true in children (Barlow 2002). However, few individuals with OCD consider their obsessions as totally senseless (Barlow 2002).
The age of onset is usually late adolescence to the early 20s, and it rarely begins after age fifty (Barlow 2002). It can appear in childhood even before the age of five (Barlow 2002). Specifically, according to one author (Steketee 1993), 65% of OCD cases become symptomatic before the age of 25, 30% reporting symptoms as children, and 15% developed symptoms after age 35. The illness is more likely to begin earlier in young males, usually in mid-adolescence (Barlow 2002). The mean onset age in males is fourteen to nineteen and half, whereas ages in females are twenty-one to twenty-two (Barlow 2002). Boys outnumber girls 2:1 for childhood OCD. However, the ratio becomes more equal for adult cases of obsessive-compulsive disorder (Barlow 2002).

OCD behaviors, such as compulsive hand washing and compulsive slowness, may differ statistically among sexes, but on average the ratio for adults remain 1:1 (Barlow 2002; Marks 1987). Females tend to be obsessional washers/cleaner, while males have obsessional slowness (de Silva 2000). For those individuals who marry, the quality of their marital relationships does not appear to be worse than that of marriages in the general population (Steketee 1993).

OCD afflicts about 2-3% of the population in the United States, according to Billet et al. (1998), but also occurs widely in China, India and Egypt (Marks 1987). However, another study in the United States identified figures of 1.1% to 1.8% for annual prevalence and 1.9% and 2.5% for lifetime prevalence-about 1 in 45 individuals (Barlow 2002). The frequencies of specific forms of the disorder are similar across cultures and periods of time (de Silva and Rachman 1998; Barlow 2002). For example, John Bunyan (1628-1688), author of Pilgrim’s Progress, was afraid he may utter blasphemous
thoughts about God, similarly, Martin Luther (1483-1543) was tormented by doubts and intrusive, blasphemous thoughts (de Silva and Rachman 1998). Samuel Johnson, John Bunyan, and Charles Darwin all had an obsessional disorder that involved collecting, ordering and organizing, and struggling with unacceptable thoughts (de Silva and Rachman 1998).

Insel et al. (1994) reviewed studies from England, Hong Kong, India, Egypt, Japan, and Norway, and showed that symptoms typical of U.S. and European studies, including fears of contamination and pathological doubt accompanied by checking were present in these regions as well. There seems to be no difference in the prevalence of OCD across races (Hispanic, African American, European-American) in the United States (Barlow 2002). The following characteristics of OCD are common: harming/religious/sexual obsession and checking rituals; contamination obsessions and washing/cleaning rituals; symmetry/ordering/certainty concerns, and counting/repeating/checking compulsions (Barlow 2002).

OCD is considered one neurodevelopmental disorder of the frontostriatal system of the brain (Bradshaw and Sheppard 2000). Areas included in this system are: the dorsolateral prefrontal cortex, lateral orbitofrontal cortex, anterior cingulate, supplementary motor area, and basal ganglia structures (Bradshaw and Sheppard 2000). The frontostriatal system is responsible for human adaptive responses to environmental circumstances involving effectively excessive release or withholding of various types of responses (Bradshaw and Sheppard 2000). Other disorders of this system are
schizophrenia, autism, and attention deficit hyperactive disorder (Bradshaw and Sheppard 2000).

It is suspected that changes in the frontal lobes or basal ganglia and perhaps the limbic system may be involved in OCD (Hoehn-Saric and Benkelfat 1994). Steketee (1993) writes that the origins of the pathology may be in the striatum. This in turn interferes with the cortex, which must increase its activity to compensate. Thus, the orbital cortex, and maybe the cingulate cortex, serves compensatory functions for the impaired striatum. The damaged striatum cannot screen impulses, thoughts, and motor behaviors (Steketee 1993).

Scientists have examined cerebral functioning in OCD patients. One study using electroencephalogram (EEG) suggests a unique pattern of EEG response in OCD patients indicative of left frontal lobe dysfunction (Stanley and Prather 1993). Some studies used other measurement techniques (X-ray computed tomography, positron emission tomography and single photon emission computed tomography) to study cerebral dysfunction (Stanley and Prather 1993). X-ray computed tomography analyses suggest that OCD is associated with larger ventricular-to-brain ratios and smaller caudate nuclei volumes (Stanley and Prather 1993). Further studies suggest increased glucose metabolic rates in the orbital cortex and the striatum as well as a higher ratio of medial-frontal to whole cortex blood flow in OCD (Stanley and Prather 1993).

Positron Emission Tomography of brain function revealed metabolism within cingulate cortex, thalamus, and pallidum/putamen was greater in OCD patients compared to controls, and the metabolism of cerebral hemispheres, head of caudate, and orbital gyri
in OCD patients was greater than controls. In addition to these studies, Stein et al. (1994) related that OCD patients demonstrated greater soft signs (neurological phenomena that occur in the absence of evidence of neurological disease, such as involuntary movements) than normal controls.

The first indication that obsessive-compulsive disorder was mediated by a specific neurochemical system was the discovery that clomipramine, a predominantly serotonergic tricyclic antidepressant, was useful in its treatment (Stein et al. 1997). Pharmacotherapeutic dissection, neurochemical assays, and pharmacological challenges indicate that serotonin plays an important role in OCD (Stein et al. 1997). Selective serotonin reuptake inhibitors (SSRIs) and dopamine blockers obviate OCD symptoms (Stein et al. 1997).

High levels of the serotonin metabolite 5-hydroxyindoleacetic acid (5-HIAA) in cerebrospinal fluid (CSF) is associated with increased symptomatic activity in OCD, according to neurochemical assays (Stein et al. 1997). Furthermore, these assays may lead to the postulation that increased serotonergic activity is characteristic of compulsivity, while decreased levels are representative of impulsivity (Stein et al. 1997). Pharmacological challenges support a hypothesis stating that in obsessive-compulsive disorder certain parts of the brain are characterized by serotonin hyperresponsivity, while other brain areas were hyporesponsive to serotonin (Stein et al. 1997).

Research has shown that OCD responds best to the serotonin reuptake inhibitors mentioned earlier (Rubin and Harris 1999). These inhibitors block serotonin transporters and increase synaptic serotonin levels. The synapse is the junctional complex, or space,
allowing intercommunication between neurons. The serotonin system plays a role in regulation of a variety of functions and behaviors, such as feeding, thermoregulation, sleep, pain, arousal, sex, biological and neuroendocrine rhythms, addiction, impulsivity, anxiety, depression, and OCD (Jacobs and Fornal 1995).

Billet et al. (1998) states that some people do not respond to SSRIs, and thus some other neurotransmitters or chemical substances may be involved in OCD symptoms, such as dopamine. In addition, certain animal models of compulsive behavior can be induced by dopaminergic agents (Billet et al. 1998). Dopamine synthesis occurs mainly in the substantia nigra and ventral tegmental area of the midbrain (Keltner 2003). The dopamine system would seem important in OCD in view of its role in stereotypic behaviors in animals (Stein 2000). Also, cocaine has been shown to exacerbate OCD symptoms by blocking presynaptic dopamine uptake (Nicolini et al. 1996).

Billet et al. (1998) stated that there is solid evidence for the involvement of genetic factors in the etiology of obsessive-compulsive disorder. There are at least four types of evidence that suggest genetic factors in OCD, according to Pauls et al. (1991): higher concordance rate among monozygotic twins compared to dizygotic twins, a significant aggregation of the illness within families, higher incidence of the trait among biological offspring of affected individuals, and genetic linkage of OCD with an identifiable allele at the marker locus.

The twin method consists of comparing the number of monozygotic twins (MZ) in which both pairs are concordant (affected) with the number of dizygotic (DZ) twin pairs concordant for the trait of interest (Pauls and Alsobrook 1999). Twin studies, unlike
family studies, can separate genetic and environmental sources of familial aggregation (Jonnal et al. 2000). One study reports that eighty-seven percent of monozygotic twins were concordant for “subclinical OCD” (obsessional features) compared to forty-seven percent of dizygotic twins (Rasmussen 1994). Another investigation, using a sample of 419 pairs of MZ and DZ twins, revealed that MZ twins are more highly similar for obsessive-compulsive symptoms than DZ twins (Jonnal et al. 2000).

Familial aggregation of an illness is a necessary consequence if it is genetically transmitted (Pauls & Alsobrook 1999); however, families also transmit environmental and cultural factors to future generations (Pauls & Alsobrook 1999). Two methods are used in genealogical studies of OCD; the family history method and the direct interview method (Pauls and Alsobrook 1999). Using the family history method, one study reported that of 306 first-degree relatives of OCD patients, 37 parents and 63 siblings displayed pronounced obsessional traits (Pauls & Alsobrook 1999). After either of these methods is completed, a segregation analysis may be done to determine whether Mendelian genetic models explain the familial aggregation (Pauls and Alsobrook 1999).

A number of candidate gene studies have been conducted with the goal of finding the molecular mechanisms underlying OCD. According to Sobin and Karayiorgou (2000) and Pauls and Alsobrook (1999), the list of genes involved in both serotonergic and dopaminergic pathways that have been tested so far remain small and include: the DRD2, DRD3, and 5HT2A receptor genes, the dopamine D4 receptor gene, the gene for the serotonin transporter, and the COMT gene. The COMT gene, which has not been discussed up to this point, is a key modulator of dopaminergic and noradrenergic
neurotransmission, and it maps to the q11 band of human chromosome 22. Absence of
22q11 band is associated with anxiety and OCD in children and adolescents (Sobin &
Karayiorgou 2000).

As hopefully conveyed by this overview, obsessive-compulsive disorder has a long
history as well as a biological foundation. There are some treatments for OCD other than
drug therapy such as: behavior therapy, cognitive behavior therapy, exposure and
response prevention, systematic desensitization, contingency management,
psychotherapy, hypnotherapy, group therapy, psychosurgery, and electroconvulsive
therapy (de Silva & Rachman 1998). The evolutionary explanations reviewed in this
thesis could advance the theory and practice of behavior-based therapy.
Chapter IV

Evolutionary Explanations of Obsessive-Compulsive Disorder

The following topics refer to circumstances in which OCD is adaptive, where certain evolutionarily stable strategies (ESS) are used. The final portion of this chapter illustrates a Darwinian approach to OCD with examples from nonhuman animals. Before going any further, I would like to clearly differentiate obsessions from compulsions.

Obsessions are intrusive, seeming bothersome thoughts concerning potential sources of danger, usually followed by “stereotyped” and repetitive behaviors, or compulsions, perhaps meant to reduce anxiety caused by the obsessions (Boyer & Lienard 2006). Obsessions can be generally labeled as thoughts of “contamination and contagion,” “possible harms to others,” and “social rejection” from shameful or aggressive, or any socially unacceptable behavior toward others, including strangers (Boyer & Lienard 2006). These “labels” are not mutually exclusive, one person may have symptoms from each “label.”

In addition, these intrusive thoughts may be associated with “thought-action fusion,” an assumption on the part of the individual that one’s ruminations concerning possible danger or problems will actually bring them about (Boyer & Lienard 2006). Increased vigilance and exaggerated feelings of responsibility for others is common (Boyer & Lienard 2006).
Compulsions are usually ritual-type behaviors (rituals described later) following the obsessions (Boyer & Lienard 2006). These are usually action sequences repeated many times over with the intention of reducing anxiety caused by intrusive (obsessional) thoughts. For example, one may have to group objects in particular numbers with a specific alignment to make a seeming uncontrollable situation more controllable (Boyer & Lienard 2006). Three “dimensions” of OCD are: “contamination,” “insecurity and doubt,” and “excessive precautions.” These “dimensions” provide a framework within which any symptoms can be distributed (Boyer & Lienard 2006). Older organizations of symptom-types used three basic categories: “checkers,” “washers,” and “hoarders.”

Distinguishing abnormal (psychopathological) from normal obsessions and compulsions is challenging since all humans show obsessive and compulsive behaviors. Some authors say the content of the obsessions and compulsions may be similar, but the important distinguishing factors are frequency and resistance, not content (Muris et al. 1997; Rassin & Muris 2006). This section of the thesis accounts for situations in which all humans have the capacity to display symptoms of what is medically called OCD.

I do not think the symptoms characteristic of what is known as OCD should exist under the single name OCD. A maladaptive obsessive-compulsive trait complex, or a maladaptive set of obsessive-compulsive traits, should be made on an individual basis relative to the life history stage of the patient, the specific events occurring at the time in the patient’s life as well as how their specific set of traits, or behaviors, distress them. Perhaps this would help professionals decide whether someone is better off on just medicine, just therapy, both medicine and therapy, or neither, and could help them
determine a given length of time an individual should be on a medication. I am just trying to suggest that maybe what is called OCD is not sufficient enough to determine maladaptive and adaptive forms of OCD. Literature by Szasz (1960, 1999) and Nesse (1991) discuss some others ways to identify, test, and diagnosis diseased states like OCD and depression (though not OCD specifically).

One other commonly used term in any discussion of obsessive-compulsive disorder is “ritual.” Ritual is defined in this paper “as stereotyped series of actions, performed by individuals or groups, which have a function or meaning beyond its surface meaning, and it may be associated with emotional release” (Turbott 1997). Rituals are seen in individual actions at various life-history stages (childhood through adulthood) as well as those performed at a group level, such as religious ceremonies (Boyer & Lieland 2006).

Boyer & Lienard (2006) identity five characteristics of ritual behaviors: “compulsion” (may relieve anxiety, it does not require explanation); “rigidity, adherence to script” (ritual must always be performed the same way); “goal-demotion” (for example, washing one’s hand beyond the necessary number of times to make them clean); “internal repetition and redundancy” (ritual behaviors are repeated a specific number of times); and “a restricted range of themes” (e.g., hygiene, preventing dangerous situations, or to promote order or structure in the living space).

**OCD in Childhood Defense Rituals**

One explanation for the etiology of OCD is as a defense against some feared or traumatic event, specifically more of an anti-stress defense mechanism prevalent in
childhood rituals. In other words, obsessive-compulsive behavior may be seen as a type of defense ritual. Childhood and adolescence are periods of significant growth and development. These age groups are exposed to more dangers than adults due to physical and emotional vulnerability (Bogin 1995).

Therefore, it would seem appropriate for young people to have an enhanced sense of responsibility to prevent danger to themselves, whether this danger is a carnivorous predator or the peer pressure of socialization. I believe this may explain why OCD usually starts early in childhood. Childhood here refers to the three developmental stages known as childhood, preadolescence, and adolescence. However, giving each stage a specific numerical value (e.g. childhood ends at twelve years of age) can be somewhat subjective.

Some childhood rituals include: ritualized games and collecting or stereotyped dressing before meals. These behaviors may help young people gain cognitive control (Turbott 1997). Specifically, Swedo et al. (1989) described 70 cases of childhood and adolescent OCD and found washing in 85%, repeating in 51%, and checking in 46%. All children, not just those with OCD, develop elaborate, rigid routines starting at about 2.5 years old, which begin to “crystallize” by 4 years of age (Feygin et al. 2006). Also, during adolescence, the young person experiences physical and mental (e.g. psychological) changes which may be refined by obsessive-compulsive behaviors.
**OCD in Religion**

As stated earlier, OCD occurs across many regions, including the United States, China, and Egypt (Marks 1987). One particular cultural facet shared among numerous populations of these countries is some form of religion. Freud described religion as the “universal obsessional neurosis of humans” (Stevens and Price 2000). Every religion has beliefs and practices which employ ritualized behavior, perhaps to manipulate the gods with objectives such as more rain, fertile growing seasons, and fulfilling a quest for salvation (Turbott 1997).

The compulsive rituals associated with OCD bear a close resemblance to the religious rituals practiced all over the world (Stevens and Price 2000). For example, compulsive cleaning, a characteristic of OCD, is similar to the compulsive purifying practices of religious leaders. Studies show that reared-apart (different family environments) identical twins share similar forms of religiosity (Wright 1998). If one twin was religious, his or her identical twin was most likely religious as well; conversely, when one twin was a nonbeliever, the other was too (Wright 1998). This suggests a genetic component to a proclivity for religious faith or beliefs.

Individuals with OCD make sure a task is completed to avert danger, similar to the purposeful behavior religious followers use to appease a deity. In fact, a study carried out in Egypt on Christians, Hindus, Muslims, and Jews with OCD symptoms found that the most common obsession was related to contamination, but the different cultural norms determined the specific appearance of the obsession (Montgomery & Zohar 1999).
Religious background can influence the specific content of obsessions; however, the core themes and compulsions remain the same (Montgomery & Zohar 1999).

Roman Catholicism has two sacraments that must be repeated frequently, one of which is confession (Hollander et al. 1994). Martin Luther, a Catholic monk, before founding Protestant Christianity, spent many hours ruminating over transgression and repeating them in confession (Hollander et al. 1994). There are cases of obsessive urges of blasphemy or of illness and harm coming to people during Protestant pray (Hollander et al. 1994).

Muslims and ultra-orthodox Jews participate in what may be called OCD behaviors during religious rituals. For example, the Muslim practice of Al-Woodo requires the practitioners to clean the five orifices of the body three times after the using the toilet or after intercourse and to pray five-times daily (Hollander et al. 1994). Furthermore, Waswas, a condition of verbal and physical repetition, is practiced by Muslims during religious prayer (Pfeifer 1994).

**OCD as a Parental Preoccupation Defense Mechanism**

Early parental preoccupations and behaviors (EPPB) surrounding the birth of a new family member have been compared to characteristics of obsessive-compulsive disorder (Mayes et al. 1999). These authors cite evidence of parental caregiving models for an evolutionary origin of OCD which includes: an increased risk of onset or exacerbation of OCD among mothers in the last weeks of pregnancy and during the postpartum period; similar neurobiological pathways in the maintenance and initiation of maternal behavior.
and in the pathobiology of OCD; similarity between overall characteristics of OCD and the content of EPPB; and the perceived similarity between the adjustments made in a family with a neonate and the nature of the pathological accommodations made when a close family member has OCD (Mayes et al. 1999).

Results show that time spent thinking about a neonate increases soon after birth (Mayes et al. 1999). Mothers in the study reported that they spent fourteen hours a day thinking about the baby while men spent seven hours. Proximity to the child also increased, which promotes a stronger attachment bond between mother and infant. Mothers tended to spend less than three hours a week on average away from home while fathers spent forty hours away (Mayes et al. 1999).

Parents in this study exhibited “anxious intrusive thoughts associated with harm avoidant behaviors (AITHAB).” This behavioral complex was similar to the obsessions and compulsion of OCD (Mayes et al. 1999). All forty-one parents studied by Mayes et al. (1999) reported recurrent worries about the health of their child. In fact, 95% of mothers and 80% of fathers were concerned about the possibility of something bad happening to their baby (Mayes et al. 1999). Several parents reported intrusive thoughts about their capacity to be good parents.

Some even reported thoughts of harming their unborn child. In response to anxious behavior or unpleasant thoughts, 73% of mothers and 49% of fathers reported checking the unborn child’s movements in utero, and 71% described the need to check even if everything was fine (Mayes et al. 1999). Parents continued to report recurrent thoughts of harm to the infant by themselves or some outside force (Mayer et al. 1999).
Continuing to check was a similar response by many parents. Parental separation anxiety was also prevalent among the individuals under study. In fact, Rapopart (1989) mentions a case study of Dr. S, whose OCD increased with the birth of his first child, after it had been in remission for some time.

Negative emotions felt by the parent, like fear, sadness, and anger, and anxiety, are normal before birth and postpartum (Hagen & Barrett 2007). These feelings are typically directed at the new child. Hagen & Barrett (2007) hypothesized that perinatal and postpartum sadness felt by new mothers could be adaptive. They interviewed mothers of the Shuar, a hunter-horticulturalist society in the lowlands of Amazonian Ecuador, concerning perinatal and postpartum experiences (Hagen & Barrett 2007).

Maternal sadness forces the new mother to evaluate any costly circumstances contributing to her sadness, relating to her pregnancy (Hagen & Barrett 2007). She may then seek some help from relatives who can provide social and material resources to help the new mother care for her offspring, or if the costs of parent investment are high and no help is available, she may reduce investment in the offspring (Hagen & Barrett 2007). The authors found that fitness costs from pregnancies or offspring that outweigh any benefits the mother may gain from investing resources in a child will “elicit perinatal sadness” (Hagan & Barrett 2007). This is particularly true in Shuar society where increasing family size may hinder normal childhood growth and development (Hagen & Barrett 2007).

The presence of time-consuming and intrusive thoughts with a heightened sense of responsibility is characteristic of OCD (Mayes et al. 1999). The adaptive value of this
lies in the significance of heightened sensitivity. The period immediately following birth is a risky time for newborns (Mayes et al 1999). Greater protection and care for an offspring promotes its survival and future reproductive success. Ultimately, the parents increase their genes in the next generation (and generations to come). In sum, some degree of obsessive-compulsive behavior is essential for reproductive success.

Maternal bonding, as modeled by Daly and Wilson (1988), consists of three processes following birth. The one of interest to this paper consists of the new mother assessing her resources with regard to the survival and reproductive success of her new offspring (Irons 1998), similar to the parents in the study by Mayes et al. (1999). The mother is attentive to the infant’s physical condition and its responsiveness.

The intrusive thoughts did not interfere with any physical or emotional care required by the infant. A majority of fathers and mothers felt distressed if they were prevented from “checking” the infant. Moreover, AITHAB was associated with mothers more than fathers in the Mayes et al. (1999) study, perhaps reflecting a higher degree of maternal bonding than paternal bonding. According to attachment theory, the mother is usually the first caregiver or attachment figure (Bowlby 1969).

Mothers maintained a closer physical proximity to infant than fathers, and the mother spent more time with a newborn. “Checking” behavior was statistically greater among mothers than fathers. However, both parents participated in childcare activities. In sum, one evolutionarily relevant aspect of OCD is the reproductive benefits infants receive. They reap the reproductive awards of greater maternal bonding and overall parental care. The fitness for both parents and offspring increases.
OCD in Human Mating Behavior

Another evolutionary explanation for obsessive-compulsions (OCD) derives from its possible association with romantic love (Akiskal et al. 1999). One can say romantic love is any intense attraction expected to endure for some time in the future (Janowiak and Fischer 1994). As discussed later, romantic love is an “attachment process” that results in bonds similar to those between mother and infant (Hazan & Shaver 1987). Symptoms of romantic love include ‘obsessive’ pre-occupations with a partner and consequently an increased probability of bonding and faithfulness in the relationship (Akiskal et. al. 1999).

Romantic love results from biologically-based behavioral systems (Bartels & Zeki 2000). One particular study by Bartels and Zeki (2000) examined the neural basis of romantic love. Volunteers for this project were recruited from posters and via the Internet. They were supposedly “truly, deeply, and madly in love.” Eleven countries and several ethnic groups were represented (Bartels & Zeki 2000). Using fMRI, the authors scanned the participants as they viewed colored pictures of their boy- or girl- friend and three friends of the same age as their loved one.

The activity was restricted to areas in the medial insula and the anterior cingulate cortex and, subcortically, in the caudate nucleus and the putamen (Bartels & Zeki 2000). Activation of these areas resulted from seeing pictures of the loved ones compared to pictures of their friends. It is interesting to note that cocaine elicits a euphoric high from activity in the neural areas mentioned above, suggesting a link between romantic love and euphoria (Bartels & Zeki 2000). Deactivation (friends vs. loved partner), after viewing
the loved ones, was observed in the posterior cingulate gyrus and in the amygdala (Bartels & Zeki 2000). Activity in the amygdaloid region correlates with fear, sadness, and aggression; according to this study, the amygdaloid region was more active when the volunteers saw a friend than a loved one (Bartels & Zeki 2000).

The study of romantic love was for some time confined to only Euro-American cultures (Jankowiak & Fisher 1994). One study by Jankowiak and Fischer (1994) studied ethnographic work or a culture’s folklore to learn if romantic love was present. They used 166 societies from Circum-Mediterranean, Sub-Saharan Africa, East Eurasia, Insular Pacific, North America, and South and Central America (Jankowiak & Fisher 1994). It appeared that more than 88.5% of the societies had an incident of passionate love; however, the other nineteen cultures that did not show romantic love most likely resulted from ethnographic oversight. Also, the data suggests that romantic love is a human universal or near-universal, and it is not limited to Euro-American cultures (Jankowiak & Fisher 1994).

Using twenty subjects who had recently fallen in love (within the previous six months), twenty unmedicated subjects with OCD, and twenty normal controls, Akiskal et al. (1999) found low levels of serotonin in the subjects who had recently fallen in love and the subjects with unmedicated OCD relative to the normal subjects (control). Therefore, it is conceivable that obsessive-compulsive behavior characteristic of OCD is a significant factor in mating behavior. Moreover, jealousy displayed by OCD individuals toward their spouses may have evolved to maintain fidelity of a partner and prevent extramarital copulations in a sexual context (Stevens & Price 2000). This would have
highly significant value because of the increased chance of generational gene transmission with fewer male competitors.

**Nonhuman Animal Models of OCD**

Inclusive fitness and reproductive fitness of offspring are not solely human issues. All animals must reproduce to leave their genes in future generations. Dodman et al. (1997) proposed that compulsive behavior found in nonhuman animals resembles the behavior of humans with obsessive-compulsive disorder. OCD is a type of anxiety disorder (Turner et al. 2001), and anxiety-like disorders have been found in rhesus monkeys (Suomi 1986). In fact, expressions of anxiety are omnipresent in all advanced primate species, especially in certain individuals of particular ages under specific environmental conditions (Suomi 1986).

Animal models, defined at this point in the paper, refer to experimental efforts to reproduce in nonhuman subjects the characteristics of human conditions (Suomi 1986). These models are useful only as much as they can generalize to the human traits or disorders being modeled. Since verbal verification is not attainable from nonhuman primates, one must depend on the subjects’ external and internal activities under certain environmental conditions (Suomi 1986). Young rhesus macaques involuntarily separated from their mother, peers, or any attachment object will display some form of anxiety, characterized by elevation in heart rate, body temperature, and immediate activation of the adrenocortical system (Suomi 1986). However, the level or degree of anxiety is dependent on the age of the rhesus monkey and on the individual itself (Suomi 1986).
Studies show that genetically-related rhesus monkeys reared under identical environmental parameters are more likely to share the same relative stress reactivity, even if they are not nurtured by their biological mother and do not interact with each during maturation (Suomi 1986). Therefore, it can be said that there is a genetic component to anxiety and some environmental factors, such as number of separation times (Suomi 1986). According to Suomi (1986), some principles from the rhesus monkey data that can be applied to humans. One principle is that some displays of anxiety are developmentally sound and most likely shaped by natural selection; in fact, if an individual fails to display anxiety in certain situations, some adaptive behavioral systems (e.g. fight/or flight behaviors) may be dysfunctional.

Dog and cat models of anxiety have demonstrated instances of OCD-like behavior in nonhuman animals. In these examples, one observes stereotypy, simple movement disorders such as tremors and tics, which is a form of “compulsive behavior.” Stereotypy is repetitive and even ritualistic (Draper & Bernstein 1979). However, recently the words compulsive and stereotypy have been used interchangeably in veterinary medicine (Dodmann et. al. 1997). Neuroanatomical evidence suggests OCD and stereotypy originate in similar brain regions and both serotonin and dopamine are involved in these conditions.

Human OCD and nonhuman animal stereotypy show a heritable component. Human OCD usually manifests itself in childhood/adolescence and the onset of animal stereotypy starts in young offspring. One function of OCD is to relieve stress or tension (Dodmann et al. 1997). Research has shown that preventing an animal from performing ritualized
behavior creates anxiety in the animal. Humans with OCD and animals showing stereotypy respond positively to serotonin reuptake inhibitors. Overall, both human OCD and nonhuman animal stereotypy can be complex (Dodmann et al. 1997).

One type of feline compulsive behavior relates to territorial defense behavior, usually typical of domestic cats. In a state of agitation or heightened affect, a cat will bite its own tail and act quite dominant. Cats with this stereotypy react positively to serotonin reuptake inhibitors similar to humans with OCD.

Grooming, according to Dodmann et al (1997), may be performed after an animal has been exposed to novel or stressful stimuli. However, at the same time grooming cleans the body surface by controlling parasites and is important for social integration, perhaps to help form and maintain attachment relationships among kin and nonkin (Dodman et. al 1997). Therefore, it is conceivable that a clean pelage may enhance a male’s bonding signal and ultimately increases reproductive success. Like human OCD, grooming may be a way to deal with stress. Both grooming and the psychophysiology of OCD are involved with similar brain regions (Dodman et al. 1997). Grooming can be activated by a number of chemicals and hormones, such as adrenocorticotropic hormone from the pituitary (Rapoport 1989). In fact, according to Judith Rapoport (1989), obsessive-compulsive disorder may be the result of an old animal instinct for safety and grooming (e.g. a nonhuman animal model of OCD etiology).

Stereotyped behavior also occurs in nonhuman primate species (Draper and Bernstein 1979). One experiment by Draper and Bernstein (1979) demonstrates such behavior. Twelve wild-born rhesus macaques were tested ten minutes each in one of three cages
(small, medium, and large). Stereotyped behavior was most common in the smaller cage. This behavior included: rapid bouncing on the floor with all four feet, bouncing using only front legs, predictable circular pacing, pacing with head thrust at regular intervals, regular pacing and recoiling from one corner of the cage, rapid pacing developing into an exceedingly fast spin or twirl on the hind legs in the center of the cage, twirling holding on to the roof, backward somersaults, unique vertical jumping, and touching one leg to a particular place on the side of the cage as the animal traveled in a fixed pattern. In the medium cage, the monkeys’ behavior included self-grooming, self-clasping, and self-biting.

In another experiment, by Davenport and Menzel (1979), nineteen chimpanzees were divided into five groups based on their individual environment, which included four restricted environmental conditions, and one enriched environmental condition. The sixteen infant chimpanzees in the restricted environment were born in the laboratory and separated from their mother on the first day of life. They lived in a restricted environment, spatially and temporally. The three other chimpanzees were wild-born and obtained when four to seven months old. They were provided with toys, exercise equipment, and attention from laboratory caretakers.

Three types of stereotyes were observed: rhythmic rocking, swaying, or turning movements involving the whole body; repetitive movements of head, hand, or lips; holding limbs in an uncomfortable position. Chimpanzees in the restricted environment developed these stereotypies during the rearing period, while wild-born chimpanzees showed few and infrequent repetitive behaviors.
Other behaviors analogous to OCD patient’s checking and cleaning rituals include displacement behavior, such as digging and hoarding rituals caused by frustration or conflict (Insel et al. 1994). Canine acral lick dermatitis (ALD), also known as neurodermatitis, lick granuloma, or psychogenic alopecia, involves “compulsive” licking of the skin on a paw or leg, leading to loss of fur and abrasion (Insel et al. 1994). It is not uncommon for a dog to scratch, lick, or bite specific areas of the skin for no apparent reason (Insel et al. 1994). A few relationships are found between OCD and these behaviors: stress enhances them, they both seem to be inherited, and the neurotransmitter dopamine may be involved (Insel et al. 1994).

Anxiety neurosis can be recognized in other organisms, such as farm animals (Croft 1979). A cow may refuse to “let down” her milk if anxious, while, a stranger will prevent a bull from mounting during mating (Croft 1979). Neurosis in horses is characterized by profuse sweats, trembling, widely dilated nostrils, and wild staring eyes (Croft 1979). It may be caused by a certain spot in a nearby road or a neurotic rider (Croft 1979). Goats led to an undesirable area will fall down as if they were having an epileptic fit (Croft 1979). The most likely explanation of neurotic behavior in farm animals is heredity with some minor influence from the environment (Croft 1979). The purpose of relating examples of inheritance in nonhuman animals is to simply illustrate a possible genetic component in anxiety.
Chapter V

Overview of Depression

There are several categories of depressive illnesses (Solomon 2001). The evolutionary accounts of depression presented later are concerned with unipolar, or major depression. However, it should be noted that unipolar and other forms of depression are not mutually exclusive. Other descriptions of depression are: acute versus mild, trauma-based versus endogenous, brief versus protracted, and small (mild) versus large (major) (Solomon 2001).

Studies of family pedigrees and identical twins show a heritable component to unipolar depression. However, monozygotic twin concordance rates are higher in bipolar than unipolar patients (Goodwin & Jamison 1990). Females tend to outnumber men two to one in unipolar depression, whereas in bipolar depression the ratio is equal (Beckham et al. 1995). In addition, it may be present in many forms of severity. Symptoms of depression cover a range of functions including affective, behavioral, cognitive, and physiological functions (Gotlib 1993). Some symptoms include: persistent hostility, disappointment, difficulty in concentration, slowed thoughts, constant hopelessness, and helplessness (Gotlib 1993).

Each year, more than 100 million people worldwide develop clinically recognizable depression (Gotlib 1993). During the course of a lifetime, it is estimated that between 8% and 18% of the general population will experience at least one clinically significant
episode of depression (Gotlib 1993). Thus, ten to twelve million Americans become
depressed each year and about two million have manic-depressive episodes (also known
as bipolar depression) (Klein and Wender 1993).

Depression is reported in minority groups, such as African-Americans. The simple
explanation is that depression results from high rates of stress due to discrimination and
extreme disadvantages (Klein and Wender 1993). However, the rate of depression in
blacks between the ages of 30 and 64 is lower than whites (Klein and Wender 1993).
Furthermore, research suggests a progressive increase in the prevalence and frequency of
depression.

A genetic component to depression is evident in its distribution in families, and its
occurrence in monozygotic and dizygotic twins (Klein and Wender 1993). The offspring
and other relatives of depressive proband have a risk of 20 to 25 percent chance of having
the illness (Klein and Wender 1993). One study found that if one identical twin had
biological depression or manic-depressive illness, the co-twin had a 33 to 70 percent
chance of having depression; they were concordant for the illness. The fraternal or
dizygotic concordance rate was about 20 percent (Klein & Wender 1993).

The neurochemistry of depression appears to involve several neurotransmitters, such
as catecholamines, noradrenaline, dopamine, serotonin, and to a lesser extent
acetylcholine. Spinal fluid that bathes the brain shows decreased amount of some
neurotransmitters (Klein and Wender 1993).

The following historical review of depression is intended to illustrate its prevalence in
different cultures across time. Mainly I am concerned with history prior to the twentieth
To understand and characterize depression, one must consult ancient and modern authors (Knoff 1975). One early mention of despair and depression is in the Sumerian tale of Gilgamesh (Spiegel 1976). In this story, a beloved one dies and is sought out by the individual who is abandoned by the death. The abandoned one mourns despairingly and inconsolably, but eventually accepts the death (Spiegel 1976).

Hippocrates related mood and anxiety, noting the alteration of the brain by black bile and phlegm, so darkening the spirit and causing melancholy (Mahendra 1987). Galen identified four humors that affect the individual: blood, melancholy, choler, and phlegm (Madden 1966). The Bible describes humankind’s desolation, despair, and depression in its vivid, sometimes graphic, narratives (Spiegel 1976). In one Biblical story, Saul was inflicted with evil spirits only to have them banished by the soothing sounds of David’s harp acting as a sort of music therapy (Mahendra 1987). Aretaeus of Cappadocia (2nd century AD) characterized what individuals today call mania and depression (Mahendra 1987). He pointed to what would later be called ‘endogenous,’ the manifestation depression without an apparent cause (Mahendra 1987).

Clarification of the concept of depression began in fifteenth and sixteenth century Europe (Mahendra 1987). In 1597, Andreas Luarentis made a distinction between melancholic temperament and the symptoms of melancholia. In fact, this was one of the earliest attempts at distinguishing between physiological variation and pathology (Mahendra 1987). Francis Bacon and Paracelsus suggested that melancholia might be a natural disease. An almost modern classification and treatment of melancholy can be
found in Thomas Bright’s *A treatise of melancholie*, published in 1586 (Mahendra 1987). Although more sophisticated definitions of depression were becoming available, there were still references to witches and demons (Mahendra 1987). King James I and VI, Reginald Scot, Johann Weyer, and John Webster believed that the ruminations of witches were caused by some mental illness. Needless to say, witch hunting continued, and the last witch executed in England was in 1684 (Mahendra 1987).

In the 17th century, Robert Burton published *The Anatomy of Melancholy* (1621). He distinguished between melancholic temperament and the state of melancholy and classified melancholy into three forms: Head Melancholy, Melancholy, and Windy of Hyperchondria-Melancholy (Mahendra 1987). Burton also believed upbringing influenced the melancholic individual. Nicholas Robinson (1697-1743) stated that melancholy was a real affliction of the mind that arose from real mechanical causation in the brain (Mahendra 1987).

In the 18th century, Haslam inquired into the neuropsychology of melancholy to better understand the condition instead of using the more popular speculative explanations, like demonology (Mahendra 1987). He is credited with the first clinical description of the condition (Mahendra 1987). Dreyssig (1770-1809), Esquirol (1772-1840), Samuel Tuke, and George Nesse Hill were active participants in the delineation of depression in the 19th century (Mahendra 1987). Between these individuals, the term melancholia was further divided, but became less over-inclusive. Hill emphasized the organic nature of melancholia, and Tuke brought the concept to the state that is recognizable to the modern
clinician (Mahendra 1987). By the 19\textsuperscript{th} century, depression was primarily seen as a disorder (Mahendra 1987).

Although this historical overview discusses evolving views of mental illness in Europe, societies and cultures outside of Europe were concerned with depression. This is particularly important because it shows that depression is not just a product of stress in contemporary industrial countries like the United States and Europe. For example, depression was found among the Inuit population in Greenland; in fact, it was quite high in this culture, about 80\% of the population (Solomon 2001). Although life may be hard in some ways in Greenland, the Danish government has provided various social support services as well as health care, education, and unemployment benefits (Solomon 2001). In light of these amenities, depression still persists in Inuit society.

Depression was also evident in past populations, such as those of the Inca of Peru at the time of Conquest (Elferink 1999). Based on the accounts of ancient chroniclers, it seems likely that depression was widespread among the Inca (Elferink 1999). This was derived from observations of the Inca themselves, the medicine they used to treat depression, and Quechua, the Inca language. Poma de Ayala, a Spanish chronicler, indicates that depression was common in the family of Inca rulers (Elferink 1999). Mayta Capac, an Inca ruler, was described as a small-minded and melancholic man. Some medicines used as remedies include: guayrero beans, pupa extract, tarco, seeds of the vilca, resin of molle, and leaves of the mocomoco (Elferink 1999). Some words for depression in the Quechua putirayay (ancient Quechua) and kusiymana (modern Quechua) (Elferink 1999).
Some common symptoms of major depression (unipolar) listed below were taken directly from the *Diagnostic and Statistical Manual of Mental Disorders (4th Edition)* published by the American Psychiatric Association (2000).

Major Depressive Disorder is characterized by “one or more Major Depressive Episodes (i.e. at least two weeks of depressed mood or loss of interest or pleasure accompanied by at least four additional symptoms of depression).” There must be a change from previous functioning, such as:

1. depressed mood most of the day, based on subjective report of observations of others
2. markedly diminished interest or pleasure in all, or almost all, activities most of the day
3. changes in weight and decrease or increase in appetite every day
4. changes in sleep pattern every day; loss of energy almost every day
5. feelings of worthlessness or excessive or inappropriate guilt nearly every day
6. symptoms cause clinically significant distress or impairment of social, occupational, or other important areas of functioning
Chapter VI

Evolutionary Explanations of Depression

“Under its [Grief] spell men are driven into ‘habits of serious Reflection…’ [Grief] ‘sharpens the Understanding and Softens the heart.’ The furrows depicted in the portraits of great men ‘were all ploughed in the Countenance, by Grief.’”

John Adams, “Founding Father”
from *Passionate Sage* by J. Ellis

The word depression may have different meanings depending on the context. In the following Darwinian accounts, depression refers to clinical or severe depression also known as unipolar or major depression. Bipolar disorder, or manic-depression, is not part of these evolutionary accounts of depression. The social navigation hypothesis (SNH) proposed by Watson and Andrews (2002) is an adaptationist model of clinical depression in which clinical depression itself is adaptive. The other Darwinian explanation included in this chapter is a social rank hypothesis; here, depressed mood has an adaptive function, but clinical or severe depression is seen as a dysregulation (maladaptive) of a normal mood state (Gilbert 1992; Sloman et al. 2003). A definition of depression in nonhuman animals is difficult, but usually based on similarities with human depressive states.
Social Navigation Hypothesis

According to the social navigation hypothesis (SNH), clinical depression is not maladaptive, but rather has adaptive functions in certain contexts (Watson & Andrews 2002). Watson and Andrews (2002) cite “good reasons” for considering an adaptationist model of depression. For example, depression is prevalent and may be found in all cultures. There are cases of depression in traditional societies like the !Kung of southern Africa (Watson & Andrews 2002). Generally, the SNH finds socially available solutions to so-called “fitness hindrances (FH),” or events that decrease a person’s fitness (loss of a job) or prevent an individual from increasing fitness opportunities (Cline-Brown & Watson 2006). Depressives tend to be more dependant on members of a social network than non-depressive (Cline-Brown & Watson 2006).

The SNH grew out of functional design models of emotional pain, a kind of analog of physical pain (Watson & Andrews 2002). Physical pain draws attention to damaged tissues, and prevents humans from possible hazards in the environment that may cause such damage (Watson & Andrews 2002). Distress associated with physical pain helps one remember the “object” of that pain and to avoid it. Also, emotional pain forces an individual to reconsider actions that could lead to high costs and no (or few) beneficial returns (Watson & Andrews 2002). Intense pain after receiving a gunshot wound should make someone contemplate more creative solutions and strategies to avoid problems in the future than perhaps they would from the slight pain of paper cut.
The onset of depression is context-dependent and is associated with crucial social problems and conflicts (Watson & Andrews 2002). Depression evolved to serve two complimentary functions. First, termed social rumination, depression focuses limited “cognitive resources” to help an individual solve critical and complex social problems, specifically social conflicts that can not be mitigated through more “conventional social negotiations” (Cline-Brown & Watson 2006). Potential social problems are loss of rank (perhaps job loss) or feeling like one is not getting the recognition or respect one deserves or maybe one needs.

The loss of interest and pleasure (anhedonia) in normal activities will allocate more time to focus on problem-solving social information and less time for hedonism (Watson & Andrews 2002). Thus, anhedonia shuts down “hedonic interests” and helps one concentrate on the current problem. Research has shown that depressives show a strong preoccupation with social information (Watson & Andrews 2002). For example, cognitive changes in depressives allow them to make a mental construction of their social situation (Watson & Andrews 2002).

The SNH predicts that depressives show improved problem-solving abilities (Cline-Brown & Watson 2006). Research shows that depressives infrequently make the fundamental attribution error (FAE), a type of judgment error where an actor’s behavior and mental state together are out-of-proportion to the situation (Watson & Andrews 2002). Also, depressives score higher on some problem-solving tests. Low serotonin levels associated with depression perturbs or slows down physical activity and increases success on difficult cognitive tasks, but exhibit lower success rates on non-social tasks,
including general learning or memory tests. They are too preoccupied with more socially-based problems (Watson & Andrews 2002).

The second major function of major depression (clinical depression) is a social motivation function (Watson & Andrews 2002). The SNH proposes that depression is not just costly to the depressive. Any members of a depressive’s social network who gain any benefits from the normal activities of the depressive might lose those benefits when a depressive episode interferes with those normal activities (Watson & Andrews 2002). Honest signaling and usually involuntary fitness extortion motivate generally reluctant members of the depressive’s social network to provide the depressive with investments and force the non-depressive partners to negotiate (Watson & Andrews 2002).

Depression and even suicidality function as a “cry-for-help.” The high costs imposed on the depressive from this honest signal would motivate reluctant social partner to answer the cry-for-help (Watson & Andrews 2002). Low mood, lethargy, and the reduced energy levels characteristic of depression do put the depressive at a higher risk of predation and viral or bacterial illnesses. Fitness extortion works when it is better for kin and nonkin (allies) to try and resolve the depressive episode, than to suffer the growing costs (Watson & Andrews 2002). The bargaining model of depression (clinical) developed by Edward H. Hagen proposes a similar social motivation through extortion.

In other cases, there is a “niche change” function of depression (Cline-Brown & Watson 2006). A person’s “social niche” is defined by the “interacting reciprocal social contracts” they have with other people in the social network and the cognitive and behavioral tools they use to build those contracts (Cline-Brown & Watson 2006). A
social niche change may require extortion behavior over a large part of one’s social network. This total “niche change” may take place due to a feeling of “social entrapment.” For example, one might have too many obligations within a very complex set of social contracts that prevents one from achieving maximum reproductive success (Cline-Brown & Watson 2006). Research shows that when a depressive’s needs are met their depression subsides.

In his book *Lincoln’s Melancholy*, Joshua Wolf Shenk (2005) suggested that Abraham Lincoln’s first suicide attempt can be interpreted with an evolutionary account of depression. Lincoln’s depression emerged at a time of need and it helped him “thrive” (Shenk 2005). Furthermore, his depression provoked assistance, and many people at the time admired his emotional disposition (Shenk 2005). His melancholic behavior was in some way attractive (Shenk 2005). Here is a passage from *Lincoln’s Melancholy*:

For whatever reason, or combination of reasons, in the late summer of 1835 Lincoln’s depression was pushed out into the open. After several weeks of worrisome behavior—talking about suicide, wandering alone in the woods with his gun—an older couple in the area took him into their home. Bowling Green, a large, merry man who was the justice of the peace—and who became, other villagers said, a kind of second father to Lincoln—and his wife, Nancy, took care of Lincoln for one or two weeks. When he improved somewhat, they let him go, but he was Mrs. Green said, “quite melancholy for months.”

**A Social Rank Hypothesis of Depression**

The following evolutionary account does not claim that depression itself is or ever was adaptive. Thus, unlike the SNH, clinical depression itself is maladaptive. According to this model, “low mood” is functionally designed for accepting subordination in social circumstances without threatening higher ranking members or using an excessive amount
of energy on status competition in which no benefits can be gained (Sloman et al. 2003; Gilbert 1992).

However, at this point, a description of the ranking system in humans is necessary. Prior to the hedonic ranking system seen in humans, competition for rank took the form of intense physical combat and threat displays during aggressive contests called “ritual agonistic behavior (RAB)” (Stevens & Price 1996). One could measure their success or failure based on their “resource holding power (RHP),” a rough measure of rank or an individual’s material advantage (Stevens & Price 1996). An individual could gauge their success in another contest by comparing their RHP to a conspecific’s RHP (Stevens & Price 1996). Unfortunately, too many defeats in these contests led to low RHP and reduced reproductive opportunities. This defeated state was originally called the “involuntary subordinate strategy (ISS)” (Stevens & Price 1996), mainly used in discussions of agonic groups (Gilbert 1992). Control of behavior in agonic group living is through threats and aggression (Gilbert 1992).

The hedonic mode of group living in humans partially grew out of the agonic mode. A competitor seeks to attract a rival, not physically intimidate them (Stevens & Price 1996). In agonic modes of group living, submission/appeasement may be a way of inhibiting aggression (Gilbert 1992). In a hedonic mode, reassurance/affiliation and reconciliation are ways of avoiding aggression (Gilbert 1992). This hedonic behavior reduces tension between different ranks making high ranking members less feared or feared in a different way than those in agonic groups (Gilbert 1992). Most members in a hedonic group are more inclined to explore the social environment (Gilbert 1992).
The human equivalent to RHP is self-esteem (Stevens & Price 1996). A new measure of self-assessment emerged called “social attention holding potential” (SAHP) (Gilbert 1992). SAHP is a measure of one’s ability to hold another’s attention in a favorable way, and to attract investment of other members of one’s social group (Gilbert 1992). A person with a high SAHP may assume a leadership role and have access to more resources (Stevens & Price 1996).

The political thought of John Adams, the second president of the United States and “Founding Father,” nicely illustrates the hedonic mode of group living in late 18th to 19th century America. This, of course, is prior to the growth and expansion of the United States that ultimately led to the intense economic, political, and social competition of recent times. Adams believed that aristocracy was “natural” and “unavoidable,” something the new nation would have to face, like all other nations throughout history (Ellis 1993).

‘That all men are born to equal rights is true,’ Adams declared defiantly…But to teach that ‘all men are born to equal powers and faculties, to equal influence in society…is a gross fraud…as ever was practiced by monks, by Druids, by Brahmins, by priests of the immortal Lama, or by the self-styled philosophers of the French Revolution.’ (Ellis 1993).

This contrasted with Jeffersonians, like John Taylor, who believed social inequality was not unavoidable in a democracy like that established in the new nation (Ellis 1993). Of all the emotions expressed by man, according to Adams, none was ‘more essential or remarkable, than the passion for distinction’…‘to be observed, considered, esteemed, praised, beloved and admired by his fellows…’ (Ellis 1993). The need for wealth and power was only a “secondary passion” that led to the real reason for accumulating wealth
(material), the need for attention and affection from others (Ellis 1993). This led Adams to declare that the main reason for a government, one with “checks and balances,” was to control these “passions” inherent in human nature that inevitably led to competition and social inequality (Ellis 1993).

Sloman et al. (2003) proposed an “adaptive range” of depression (general term). Severe or clinical depressions are maladaptive effects of “prolonged use of short-term adaptive (stress) defenses” (Sloman et al. 2003). What makes an evolutionary mechanism adaptive or maladaptive depends on its range of duration and intensity within a particular context (Sloman et al. 2003). For example, a short-term fever may help fight an infection, but having a high fever for long time could kill someone.

The Involuntary Defeat Strategy (IDS), formerly called the involuntary subordinate strategy (ISS), is an innate strategy activated by an individual’s awareness that defeat in some type of social competition is inevitable (Sloman et al. 2003). The IDS reduces the risk of injury by activating submission or flight. At the same time, the IDS promotes acceptance of any loss of social rank (Sloman et al. 2003). Thus, it is a dysregulation of the IDS specifically that may lead to clinical depression (according to a social rank hypothesis).

The IDS can usually be terminated through programmed biological processes; if not, however, an overly powerful and damaging IDS may lead to clinical depression, for example (Sloman et al. 2003). Other members in a social network (e.g. external influences) may continue to act aggressively toward someone who has already submitted,
potentially leading to clinical depression in the person who has submitted (Sloman et al. 2003).

Nonhuman Animal Models of Depression

Principles of behavior, in some respect, are better illustrated by nonhuman animals (Ridley 1993). Humans, unfortunately, have no concrete way of communicating with such animals, and cannot detect specific feelings from them, such as depression. Therefore, it is not possible to find an exact analog between human depression and that found in nonhuman animals (if depression is even a condition characteristic of nonhuman animals); however, one does find features of human depression, such as stress, separation-anxiety due mother-infant separation, and social loss, in other animals. It is important to remember that humans and some nonhuman animals have shared an evolutionary past (Grandin 2005). It would he somewhat anthropocentric to assume that nonhuman animals do not have emotions.

Before discussing depression in nonhuman animals, introducing some general definitions of stress response and learned helplessness may be wise. Stress response is an adaptation, a defense that ultimately gives the carrier a selective advantage (Nesse & Young 2000). In other words, stress is a form of “defense arousal” activated when an organism is in danger (e.g. damage or loss of resources) (Nesse & Young 2000). Arousal is accompanied by physiological changes to prevent damage to the individual (e.g fight or flight) (Nesse & Young 2000)
In learned helplessness models, animals are subjected to uncontrollable trauma and henceforth exhibit “performance deficits” (Gilbert 1992). These models are based on experiments with dogs that were prevented from taking action against an incontrollable trauma (or negative force), such as an electrical shock (Gilbert 1992). Then, when given the opportunity to escape from this negative force, the animals remained unmotivated; they would not “liberate” themselves.

Learned helplessness shows considerable behavioral analogy to human depression (Petty & Sherman 1979). In fact, rats exposed to learned helplessness models (shock test box) showed changes in “performance deficits” after imipramine (Petty & Sherman 1979). The deficit time dissipated faster and they returned to normal behavior. Imipramine is an antidepressant used similarly in humans to reduce and control depression (Petty & Sherman 1979). In addition, there is not major conflict between ranking theory and helplessness theory (Gilbert 1992). Both of them explain “perceived defeat” and the “controllability” of behavioral outcomes and responses (Gilbert 1992).

Nonhuman primates have been used extensively as models for human conditions such as grief and bereavement, social conflict, and aggression (Laudenslager & Worlein 1999). In fact, the nervous, endocrine, and immune systems of such nonhuman primates are “morphologically and physiologically” similar to those of humans (Laudenslager & Worlein 1999).

Social loss in humans is often followed by sadness and depression (Ladenslager & Worlein 1999). These may contribute to changes in sleep, eating habits, and activities. Human social loss, perhaps from rank demotion, may be understood in the context of
young macaque monkeys’ social loss due to maternal separation (Laudenslager & Worlein 1999). The initial phase of separation is agitation followed by depression. Separation leads to withdrawal, reduced activity levels, and a decline in social interactions and play behavior (Laudenslager & Worlein 1999). However, according to research by Kaufman (1979), motherless infants gradually began to interact with their environment. There were also alternating periods of depression and play as well as the exploration of inanimate objects. (Could this alternate period of play and exploration be similar to the manic phase of bipolar disorder?)

In one study presented by Mckinney & Bunney (1979), four pigtail monkey infants were removed from their mother. They all showed distress; in addition, there was a phase of agitation-sitting hunched over with their heads down between their legs-and a period of decreased activity. Social interaction and play behavior ceased. These authors also stated that loss of appetite, weight loss, decreased motor activity, and a loss of interest in the environment is characteristic of nonhuman animal depression. These monkeys are not the only species affected by social separation.

In addition, physiological and immunological changes occur in young macaques when their mothers are removed from the social group. Again, like depressed humans, one observes decreased total sleep, lower heart rates and body temperature, changes in circadian rhythms, and the proliferative response to T-cell mitogens was decreased (Laudenslager & Worlein 1999). Furthermore, antidepressants (SSRIs like fluoxetine) used for human depression seem to be effective for young macaques (Laudenslager &
Worlein 1999). In addition, administering imipramine (tricyclic antidepressant) to rhesus monkeys alleviates their response to separation (McKinney et al. 1984).

Separation of human infants from their mothers is the cause of “anaclitic depression,” a period is characterized by weepiness, withdrawal, rejection of the environment, slowness of movement, loss if appetite, insomnia, and increased finger-sucking (Kaufman 1979). “Anaclitic depression” is similar to a pigtail infant’s symptoms after maternal separation (Kaufman 1979).

Although the preceding focused on maternal separation, the stressors in a nonhuman primate’s life changes during growth and development. Juvenile rhesus monkeys that lived together for two months showed signs of protest (McKinney et al. 1984). Protest behavior includes increased activity and consumption of less food (McKinney 1984). Adolescent and adult monkeys are more involved in dominance hierarchies. Price (1967) suggests the behavior going down the hierarchy is depression. This is also adaptive since it prevents the descending animal from fighting back.
Chapter VII

Linking Evolutionary Explanations of Mental Illness to Attachment Theory

Attachment theory is a common thread among the hypotheses reviewed in this thesis. As mentioned earlier, obsessive-compulsive disorder (OCD) could have a functionally designed role in romantic love relationships. Adult attachment behavior was first applied to romantic love relationships, or those bonds between married couples (Hazan & Shaver 1987). Others have attempted to apply attachment theory to religion, mainly the three Abrahamic traditions, by comparing worshipers’ attachment to the god to those attachment bonds between mother and child (Kirkpatrick 2005).

In 1969, John Bowlby published the first volume of his *Attachment and Loss* set, followed by the volume two in 1974 and volume three in 1981. Volume one, called “Attachment,” contains his theory of attachment in humans, though he draws on some observations of nonhuman primates (1969). The basic foundation from which he developed attachment theory is presented in the first parts of volume one. Two particularly important source materials for attachment theory are psychoanalysis, as developed by Sigmund Freud and others, and ethology (Bowlby 1969).

Bowlby (1969) also emphasized an evolutionary framework underlying some aspects of human social behavior, even before E.O. Wilson published *Sociobiology: The New Synthesis*. He specifically pioneered an early Darwinian approach to understanding the mother-child attachment bond and its development. He introduced a concept called
man’s environment of evolutionary adaptiveness (EEA). According to this model, the adaptiveness of modern human behavior must be considered relative to the environment man inhabited “for two million years until changes of the past few thousand years led to the extraordinary variety of habitats he occupies today (Bowlby 1969).” Therefore, the adaptive origins of human social behavior as seen today cannot be understood without reference to this two-million year period (Bowlby 1969). The enormous variability of human habitats and rapid cultural changes is too different from any modern environment occupied by “civilized” or “uncivilized” man (Bowlby 1969). The EEA concept was meant to solve this dilemma. Evolutionary psychologists sometimes call the EEA the “Pleistocene,” a statistical amalgamation of past adaptive environments.

Most of what follows is reviewed from the first volume of Attachment and Loss by John Bowlby (1969). Attachment behavior is considered a type of social behavior with a biological function. Thus, to Bowlby, attachment is instinctive, or “prepared for”, in both mother and child and is a species universal behavior. Attachment is a biological system of behavior meaning it has its own function and design, and its own ontogeny. Attachment behavior most likely evolved to protect young against predators. That is its function.

This behavioral system has as its “aim or goal” proximity to a principal attachment figure, usually being the mother in human infants/children, who is also the main caregiver (Bowlby 1979). The attachment system is activated when an individual (child or adult) is sick or in trouble, and is elicited with greater intensity when the object of the attachment relationship (child or adult) is separated from the attachment figure and scared
Otherwise, the attachment system is inactive, allowing for the activation of other behavioral systems (exploratory or affiliation) (Hazan et al. 2006).

Four traits must be present in any attachment bond. One trait is termed proximity maintenance, in which the infant stays near the mother and always monitors the mother’s present location (Hazan et al. 2006). The infant goes to the attachment figure for comfort (termed safe haven), and is distraught during separation (termed separation distress) (Hazan et al. 2006). Exploratory behavior begins when the mother is near the infant and remains sensitive to his needs (known as secure base) (Hazan et al. 2006).

John Bowlby (1969) outlined four phases in the development of infant-caregiver attachments. In phase one, “preattachment,” infants do not discriminate between potential attachment figures, but they are actively engaged in social interaction. Phase one happens between 0 to 2 months of age (Bowlby 1969; Hazan et al. 2006). Phase two, or “attachment-in-the-making,” begins around 2 months and ends around 6 months of age. At this time, infants direct signals (smiles, cry) differently towards more specific caregivers and responds to certain individuals. In other words, the infant’s developing attachment bond is less generalized (Bowlby 1969; Hazan et al. 2006).

During phase three, or “clear-cut attachment,” the infant responds to a principle attachment figure and designates other people as secondary (subsidiary) attachment figures. This behavior as well as separation anxiety is observed by 7 months (Bowlby 1969; Hazan et al. 2006). Attachment behavior can only be called such when the infant recognizes the mother and tends to maintain physical proximity to the mother (Bowlby 1969). Attachment hierarchies of multiple attachment figures form in infancy and
childhood (Hazan et al. 2006). For example, a mother may be a primary attachment figure, the father or siblings may be secondary attachment figures (Hazan et al. 2006).

Phase four is “goal-corrected partnership” or “goal-directed” meaning it is designed to maintain both proximity and social communication between the attachment figure, or “preferred individual who is conceived of as stronger and/or wiser,” and child (and even adult). At this stage, an infant infers the mother’s intentions and gains some knowledge of the caregiver’s feelings (Bowlby 1969; Hazan et al. 2006). Bowlby (1979) said attachment behavior is a part of human life “from the cradle to the grave.”

Mary Ainsworth refined attachment theory by identifying three styles of attachment: secure, anxious/ambivalent, and avoidant (Bretherton 1992). She could almost be called the “founding mother” of attachment theory. In 1953, Ainsworth performed the first empirical study of attachment theory in Uganda. Her sample size consisted of twenty-six families with “unweaned babies” ranging from ages one month to two years (Bretherton 1992). Ainsworth’s methods included observations of these families every two weeks for two-hour long visits over a nine month timeframe (Bretherton 1992). She wanted to determine the onset of proximity-promoting behaviors (and signals like crying) and when these behaviors were specifically directed at the mother (Bretherton 1992). Ainsworth noticed individual differences (attachment patterns) in the way a mother’s sensitivity to signals produced different reactions from the offspring (Bretherton 1992).

Returning from Uganda in 1955, Mary and her husband Leonard Ainsworth moved to Baltimore, Maryland (Bretherton 1992). In 1963, she began a second observational study of twenty-six families in Baltimore based on her Uganda study, but much more
thorough (Main 1999). Again she took note of behavioral patterns from the mother-infant interactions. Her observational methods were bit different than the typical “frequency count” data sampling used at the time (Main 1999). Ainsworth immediately recorded the specific maternal or infant behavior in its context, including the setting and the mother and infant mood at the time as well as any immediate preceding events (Main 1999). Again, individual differences were observed in how “sensitively, appropriately, and promptly” mothers responded to their infants’ behavior (signals) (Bretherton 1992). If an infant is able to attain a certain intended goal, as a result of the mother’s responsiveness, the infant, Ainsworth observed, “…develops confidence in his own ability to control what happens to him” (Bretherton 1992).

These interactive patterns were tested using a procedure called the Strange Situation. First, a mother and her infant are brought to a playroom in the laboratory, later joined by a female stranger (Bretherton 1992). The mother then leaves the room briefly, while the stranger plays with the infant, and returns. Next, the infant is separated from both the mother and the stranger, leaving the infant completely alone, followed by the return of the stranger and then the mother (Bretherton 1992). In the presence of the mother, the infants were much more exploratory. Much more interesting to Ainsworth, however, was the reaction from infants after being reunited with their mothers. Home data revealed those infants with “avoidant” or “anxious” behavior did not have “harmonious” relationships with their mother (Bretherton 1992).

Based on home experience data and the Strange Situation observations (as well as her observations in Uganda), three attachment patterns or styles emerged she categorized as
secure, ambivalent/resistant, and anxious (Main 1999). These patterns were meant to describe the individual differences in infant responses to the attachment figure (the mother) (Main 1999). Secure attachment (alternatively named pattern B) relationships are free of anxiety with regards to short-term separations from the mother figure (Main 1999). Exploratory behavior is engaged both before and after a brief maternal-infant separation (Main 1999). Secure bonds are characterized by emotional security and a growing sense of the self as worthy of giving and receiving affection (Stevens & Price 1996) This inner working model of the self affects the individual into adulthood and may contribute to a positive (secure) or negative (anxious/ambivalent, avoidant) adult relationship. Secure attachments blossom from a mother’s engaging sensitivity, she is a “secure base,” and an infant’s enjoyment of close physical proximity (Main 1999).

Attachment relations may also be “unfavorable” (Main 1999). The attachment figure responds “insensitively” and “unpredictably” to an infant’s signals and communication (Main 1999). The mother seems to be uninterested in being a caregiver, but does not reject the infant. Temporary separation from the mother causes an “exaggerated preoccupation” with the possible locations of the missing attachment figure (Main 1999). This attachment pattern is called ambivalent/resistant (known otherwise as pattern C). The third discrete category of attachment style is avoidant or pattern A (Main 1999; however, I have also seen this called the anxious dimension). Avoidant attachment styles involve a rejecting mother and infants who become anxious and angry during only brief separation from the mother, clearly shown in the home setting data (Main 1999). However, in the Strange Situation, avoidant infants use a defensive trait technique, shown
by their intense exploratory behavior in the unfamiliar, stressful periods of the Strange Situation (Main 1999).

John Bowlby and Mary Ainsworth were mainly concerned with infant- and child-caregiver attachment bonds. Attachment system is also activated in adulthood, but attachments have different targets and take different forms (Hazan et al. 2006). Adult relationships are influenced partly by childhood experiences with a caregiver and one’s view of the self (Hazan & Shaver 1987). Two “prototypes” of attachment bonds are relationships between infant/child and parent and those between adult romantic partners (Hazan et al. 2006). I feel it is necessary to discuss adult attachment relationships in this paper, since adults were the primary sources in the earlier models of OCD and depression.

Although the intensity of the attachment bond may diminish, not as “readily elicited,” into adulthood, it is still part one’s life: “from the cradle to the grave” (Bowlby 1969; Hazan & Shaver 1987). The attachment figure will change during an individual’s life or remain the same but with reduced intensity (Bowlby 1969). Adult attachment bonds are in the form of romantic love relationship (Hazan & Shaver 1987). Some romantic love relationships between adults are attachment bonds, or those bonds serving an attachment-based function (Hazan & Shaver 1987). However, adults do not necessarily end any attachment bonds with previous attachment figures, like those from infancy or childhood (Bowlby 1969). The intensity of the original bond is diminished, but may still be maintained by a phone call or email. In other words, one’s means of communication no longer requires close proximity (Bowlby 1969).
In adult attachment relationship research, one assumes similar motivations underlie the attachment system in the infant-caregiver bond and adult romantic relationships (Hazan et al. 2006). This is only an assumption, whether developmental processes in an infant attachment system parallels that in adults remains an open research question (Hazan et al. 2006).

Differences do exist between the two mentioned attachment prototypes. The infant-caregiver relationship is not reciprocal (Hazan et al. 2006). The infant expects protection and care from their attachment figures, without making the same efforts in return (Hazan et al. 2006). Therefore, in these attachment relationships, the attachment figure’s caregiving system is activated (another innate mechanism), which responds to another person’s distress (Hazan et al. 2006). Adult romantic relationships are reciprocal and involve a sexual component. Furthermore, one’s social network increases to include kin and more nonkin relationships. These latter adult bonds involve a multi-system complex of the attachment, caregiving, and sexual mating systems (Hazan et al. 2006).

Formation of attachment bonds in adults follow from a type of “preattachment phase” termed the “proceptive program” to a decline in attachment behaviors similar to infant “goal-corrected behavior” (Hazan et al. 2006). The proceptive program in adult humans involves displays of sexual mating rituals like flirting, while full romantic attachments are characterized by a display of comforting and calming behavior, like “cuddling” and “gazing” (Crowell & Waters 1994; Hazan et al. 2006). The hypothalamic-pituitary-adrenocortical axis (HPA) and the autonomic nervous system (ANS) regulate bond
formation in human infants and adults (Hazan et al. 2006). It should also be noted that a “skewed” HPA axis may result in depressive symptoms.

Bowlby (1979) discussed his construction of “working models” to the problem of separation anxiety and its effect on self-reliance in the context of attachment bond formation in humans. Bowlby (1979) states the individual (child and adult) forms working models within himself “representing principal features of the world about him and of himself as an agent in it.” These models are both affected by and influence social experiences. Environmental input is more influential in early life (Hazan et al. 2006). Working models determine or partly determine any success in future attachment bonds in adulthood (Hazan et al. 2006). Working models may be stable during an entire lifespan, but they are not inflexible. An avoidance attachment in infancy may be more anxious in childhood, adolescence, and adulthood (Hazan et al. 2006). Abnormal psychology in the same individual may result from two or more conflicting views of the world and the self in it (Bowlby 1979).

Cindy Hazan and Philip Shaver (1987) were early researchers in adult attachment studies. Their article, “Romantic Love Conceptualized as an Attachment Process,” created a framework to conceptualize romantic love relationships in adults using attachment theory developed by Bowlby and Ainsworth. Hazan and Shaver (1987) noticed that infant-caregiver relationships and adult romantic love partners share certain features. They identified the following qualities of attachments between infants and adults: a feeling of safety when the other is nearby and responsive; both prefer close physical proximity; both feel discomfort, or insecurity, when the other is inaccessible;
both exhibit a mutual fascination with the other or even a preoccupation with caregiver/romantic partner, and both infant and adults may use “baby talk” (Hazan & Shaver 1987).

It seemed to them that the attachment behavioral system was engaged in both adult romantic love relationships and infant-caregiver relationships (Hazan & Shaver 1987). Furthermore, one implication is that individual differences should also be seen in romantic relationship (secure, avoidant, anxious). They tested the attachment-theory approach to romantic love by publishing a “love quiz” in a local newspaper to measure individual differences, or the three attachment styles mentioned above (Hazan & Shaver 1987). Their research showed that the relative frequencies of the three attachment styles were the same in this adult sample as they were in infant samples: about 56% classified themselves as secure, about 24% as avoidant, and 20% anxious (Hazan & Shaver 1987). Also, as they predicted, the different romantic love experiences reflected their attachment styles. Furthermore, the parallels they observed between infant and adult romantic attachments were supported (Hazan & Shaver 1987). They concluded that romantic love as an attachment process does serve a biological function (Hazan & Shaver 1987).

Lee A. Kirkpatrick (2005) applied attachment theory in a similar way to an individual’s attachment bond to the god figure of mainly the three Abrahamic traditions. In other words, worshippers’ attachment bond to God is not a mere analogy or metaphor for an ordinary closeness to God, but it “really is” an attachment to God (Kirkpatrick 2005). God is a “secure base” and “haven of safety” for the followers of a particular
tradition (Kirkpatrick 2005). One, like the maternal caregiver, seeks out God for comfort.

Love felt by a worshiper for God is more like that of an infant-caregiver bond than adult romantic love (Kirkpatrick 2005). For example, love toward God is not reciprocal, unlike the expected equal caregiver roles played in romantic love relationships (Kirkpatrick 2005); thus, a child’s love for a caregiver is more like God’s love for his children. Kirkpatrick (2005) states that a “love of God reflects a relatively pure manifestation of the attachment system.” She calls it “attachment-love.” Love from God to believer is a “caregiver-love” (Kirkpatrick 2005).

Individual differences in attachment experiences may affect one’s attachment behavior toward God (Kirkpatrick 2005). For example, the attachment system of an avoidant style person may determine that God is distant or uncaring (Kirkpatrick 2005). Kirkpatrick (2005) does point out that attachment system is important is understanding religion, there are other “evolved psychological mechanisms” operating in the psychology of religion. For example, God may be placed as the alpha-figure in a rank hierarchy.

I included this section on the attachment system since it seems to be a common thread in not only biological family relationships, but also in human perception or feeling toward romantic partners and even their response to religion and God. I think Berscheid and Peplau (1983) summarized the importance of close relationships in humans in the following passage:

Relationships with others lie at the very core of human existence. Humans are conceived within relationships, born into relationships, and live their lives within relationships. Each
individual’s dependence on other people—for the realization of life itself, for survival during one of the longest gestation periods in the animal kingdom, for food and shelter and aid and comfort throughout the life cycle—is a fundamental fact of the human condition.

Any mental conditions that affect close relationships or any attachment behavior would certainly be critical to the origins and maintenance of one’s social network. As mentioned earlier, Bowlby’s (1969) neo-Darwinian approach to attachment bonds laid the foundation for some evolutionary origin models of depression (Gilbert 1992). An important assumption of the social navigation hypothesis is that the depressed individual must know his relationship with others in the group. I would think knowing who is a principal caregiver, perhaps a spouse, and identifying secondary caregivers might determine the intensity or direction of exploitive behavior. In addition, if God is part of a rank hierarchy, assuming God is the alpha-figure, one’s social experience would also be affected by any placement within this spiritual-based rank hierarch.

As discussed earlier, obsessive-compulsive disorder may be functional during the formation of adult romantic bonds, postpartum care given to newborns, and religious episodes. Jealousy and some degree of obsessive preoccupation with a romantic love figure are part of the formation and maintenance of adult relationships (some variation depends on attachment style). Perhaps high maternal obsession functions to direct the infant toward forming attachment bonds with the mother, as the primary caregiver, during the preattachment period. Using God as an attachment figure might explain why people experience OCD during religious episodes. Separation from God is like being away from
a caregiver who only has unconditional love of his followers. Overall, the attachment system is a critical adaptation in both reproductive and social decisions.
Chapter VIII

Conclusion

Many important issues emerge from evolutionary accounts of psychopathology. One particularly complex, but interesting, issue concerns the criteria used to define diseases or abnormal emotional states. Perhaps new diagnoses of mental conditions and other diseases could be produced from Darwinian accounts of emotional states. Usually the extremes of any behavior (or mental condition) are abnormal, but if one does not know the functions (functional design) of emotions, the normal-abnormal dichotomy is largely subjective (Nesse 2005). Anxiety and sadness are considered negative emotions, but both were shaped by natural selection (Nesse 2005).

Nesse (2005) outlined three global categories to help identify and distinguish abnormal and normal symptoms based on a Darwinian approach (only some of the subcategories are listed):

1. Emotional, cognitive, or behavioral responses that arise from a normal system:
   - normal responses that benefit an individual’s genes at the expense of the person’s Interests
   - useful but aversive responses

2. Symptoms arising from abnormal regulation of a normal emotion or capacity.

3. Abnormalities of behavior, cognition, and emotion that arise from fundamental brain or cognitive abnormalities not primarily involved with systems that regulate emotion and behavior (like lead poisoning)

Hopefully, many useful therapies will come from the recognition of a Darwinian approach to emotion, cognition, and behavior.
An article written by Thomas S. Szasz in 1960 called, “The Myth of Mental Illness,” challenged the view that mental illnesses were “literal” diseases or physical diseases. The term “mental illness” is merely a metaphor, and thus, mental diseases are not diseases at all, unlike an observable bodily disease like Parkinson’s disease (Szasz 1960). In other words, what are called mental illnesses are not diseases of the brain, a physical and material object, but are deviant behaviors produced by the mind, a non-material object responsible for actions like “motivation and intentionality” (Szasz 1999). Mental diseases are not diseases in the “pathological sense,” meaning they are not “a derangement in the structure or function of cells, tissues and organs,” the accepted definition of disease (Szasz 1999). Therefore, diagnosing “mental illnesses” is highly subjective and cannot be equated with typical bodily diseases, like arteriosclerosis (Szasz 1999).

A part of this “myth of mental illness” doctrine is based on a belief in the mind-body (brain) dichotomy. Szasz questions the legal and moral use of involuntary admission to a hospital and the “reason of insanity” plea (Szasz 1999). Semantic issues arise when one must determine “reality” as perceived by a psychiatrist and “reality” as perceived by patients at a particular stage of life (Szasz 1960).

Szasz (“Is Depression a Disease?” 1998; see Steibel, W) thinks that depression and anxiety are part of the vicissitudes of life or just being plain human. Even in light of the ever growing body of research on neurochemical and genetic factors involved in mental disease, he still does not consider mental diseases “true” pathologies (Szasz 1999). Depression may be a matter of temperament and there are no genetics of temperament; in
other words, genes may not directly cause depression per se (“Is Depression a Disease?” 1998). Chemical changes associated with depression (e.g. fluctuations in serotonin levels) are the result, not the cause, of depression. The American Psychiatric Association and the National Institute of Mental Health do not endorse this rather postmodern view of mental health; however, Szasz’s work has been incorporated into doctrines concerning mental health in the Church of Scientology, though he is not a member of this religion. The “myth of mental illness” debate does reflect the difficulty in determining the nature of disease.

Abraham Lincoln’s political genius and his extraordinary leadership skills most certainly were affected, or even shaped, by his depression. Maybe if he could have taken a mood-altering prescription drug, like an antidepressant or psychotropic, the Civil War would have ended differently or maybe it would have never begun.

Numerous writers, painters, and composers had bipolar (and in some cases unipolar) depression (Jamison 1993). Some of these artists are: George Gordon, Lord Byron (poet), Vincent Van Gogh (painter), Edgar Allan Poe (writer), Sylvia Plath (writer), Joseph Conrad (writer), Victor Hugo (writer), Peter Tchaikovsky (composer), and Virginia Woolf (writer) (Jamison 1993). Besides Abraham Lincoln, other leaders had severe depression (usually unipolar or bipolar) such as Winston Churchill and Lyndon B. Johnson. Some of these people created beautiful images that have transcended the ages, while others have saved millions of lives and taken just as many away through war or just poor judgment. The world would truly be a much different place without them.
Bibliography


Irons, W. 1998. Adaptively relevant environments versus the environment of


role and interaction of attachment and social rank in depression. *Journal of Affective Disorder* 74: 107-121.


