

Neural Network Model: Applications and Implications

Theodore Wasserman
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Therapy and the Neural Network Model

 Springer

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Preface

The authors of this series acknowledge that the current series and this particular volume are asking a lot of readers. It is human nature to hold on to what we believe, often discarding what is discrepant from our currently held beliefs and schema. We will ask you to put aside what you have learned in school, throughout your training and have held as clinical orthodoxy, and consider the possibility that there may be a better way to understand mental health and the disorders thereof. That is never easy or comfortable. In fact, it was neither easy nor comfortable for either of us.

The current volume is the culmination of many hours, days, and years of thought, discussion, and discourse followed by more thought, discussion, discourse, and the occasional outright argument. Interspersed were many hours of scanning, reading, incorporating, and readjusting ideas based upon the newly incorporated material. Along the way, we published several articles and two books that serve as the foundation of what we have written herein. We would like to thank the wonderful folks at Springer Publishing for their ongoing support throughout this journey. In addition, we would like to acknowledge the ongoing professional consultation from Len Koziol without whose constant feedback this work would never have begun or borne fruit.

This volume, and the series of which it is a part, represents a dynamic shift from what we knew to what we need to know as we open a scientific door made accessible through multiple, newer scientific knowledge fused with the fundamentals of clinical therapies. It represents the fusion of a number of disciplines including cognitive neuroscience, neuropsychology, and clinical psychology that have, until now, somehow managed to remain distinct and largely uninformed by each other. This is unfortunate. The current model, which we anticipate to be an evolving one, represents the fusion of multiple systems across multiple disciplines.

Rather than a static cause and effect paradigm, whether it be for mental health or mental processing, we are asking the reader to go from two-dimensional thinking to applying the process of multidimensional thinking: Thinking about a paradigm from multiple dimensions, rather than simply adopting a single approach, thereby allowing for greater intellectual processing without relying heavily upon a unidimensional framework. In the world of mental health, this means revisiting,

challenging, and perhaps discarding our current fundamental beliefs regarding the etiology and treatment of mental illness.

As we said, this is no easy task and no easy ask. We think you will find the effort is worth it. The implications are tremendous for understanding mental processing, interpreting mental processing, and how to use this information to intervene in clinical settings. It has profoundly changed the way that we practice. Ultimately, it is you, the reader, who will decide if it does the same for you. We believe that it will, in doing so, open the door to a new scientific model of clinical psychology/neuropsychology.

Boca Raton, FL, USA
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Lori Drucker Wasserman
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Chapter 1

Introduction to Therapy and Neural Networks



The idea that people could be mentally ill and that they required treatment is as old as recorded human history. Throughout history, cultures based on the prevailing religious and medical beliefs have devised what they presumed to be credible treatments. For example, trephining (also known as trepanning) first made its appearance during the Neolithic Era or the New Stone Age. This process, based on the idea that human's brains were possessed or occupied by evil humors, required that a hole (or trephine) be chipped into the skull of the patient. It is thought that Neolithic humans believed that through this opening, the evil spirit(s) thought to be inhabiting the individual's head and causing their psychopathology would be released, and the afflicted would be cured. Versions of this practice continued for centuries with variations of the practice occurring through the middle ages.

Variations on the mystical persisted worldwide. As mental pathology was believed to mask and represent demonic possession, exorcisms, incantations, prayer, atonement, and other various mystical rituals were used to drive out the evil spirit. For example, in Mesopotamia, evil spirits that caused mental illness were believed to be excised by priest-doctors using magico-religious rituals. Other more humanly pragmatic means included threats, bribery, punishment, and sometimes submission of the demonic spirit. All were deemed legitimate and effective therapies for a cure.

Some recognition for advancement is owed the ancient Egyptians. Ancient Egyptians, recognizing an interactive process, recommended that those afflicted with mental pathology engage in recreational activities such as concerts, dances, and paintings in order to relieve symptoms and achieve some sense of normalcy. The Egyptians identified, very likely for the first time, the brain as the seat of mental functions. Despite these advancements, magic and incantations were still used to treat mental illnesses caused by supernatural forces such as demons or disgruntled divine beings.

In a significant break with the past, the Greek physician Hippocrates proposed disease, including mental dysfunction, stemmed from natural occurrences in the human body rather than that of religious etiology. While the mystical was no longer

considered by the Hippocratic School, knowledge of anatomy was minimal. By way of explanation, Hippocrates, and later the Roman physician Galen, introduced the concept of the four essential fluids of the human body, blood, phlegm, bile, and black bile, the combinations of which produced the unique personalities of individuals. The Hippocratic approach was more humane and believed in the healing power of nature to restore balance in the four humors. While the focus was primarily pathology in the brain, at this juncture mental health issues were still not considered primarily the province of the brain. This is highlighted by the fact that Greeks coined the phrase and espoused the belief that “hysteria” in women (or conversion disorder) was caused by a “wandering uterus”, viewed as “a living thing inside another living thing”. They practiced realignment of this wandering organ to lure it back into its proper position as the cure thereby curing the mental disease. Treatment of the mentally ill in these cultures traditionally resulted in a life of hidden confinement or abandonment by one’s family. Mentally ill vagrants were left alone to wander the streets so long as they did not cause any social disorder. Those who were deemed dangerous or unmanageable, both in family homes or on the streets, were given over to the authorities.

Midlevel Europe saw a return to the mystical and religious. Conceptions of mental illness were a mixture of the divine, diabolical, magical, and transcendental elements. Theories of Hippocrates’ four humors were applied, sometimes separately (a matter of “physic”) and sometimes combined with theories of evil spirits (a matter of “faith”). Mental illness was often seen as a moral issue, either a punishment for sin or a test of faith and character. Christian theology endorsed various therapies, including fasting and prayer for those estranged from God and exorcism of those possessed by the devil. Although mental disorder was often thought to be due to sin, other basic causes were also explored, including inadequate diet and alcohol, overwork, and grief. The care of the mentally ill was primarily the responsibility of the family. In later midlevel Europe, attitudes hardened. In the sixteenth century, individuals with psychological disorders were seen as dangerous; they were locked up to protect society which led to an increase in their mortality rate. Mental illness was considered to be of moral weakness. The mentally ill were believed to be possessed by the devil; usually, they were removed from society and locked away.

It was only in the nineteenth century that things began to change to a more modern format. Treatment focused on the environment. Recovery was linked to conditions and surroundings that resembled the comfort of home. The mentally ill were to be treated in special facilities with structured daily schedules (work therapy). Inappropriate behaviors were to be confronted with the goal of eliminating the behavior. The ultimate goal of this treatment was to restore sanity and to return the patient to society as a fully functioning, productive member. The magico-religious nature of the disorder was deemphasized.

Therapeutic treatment radically changed during the twentieth century but, even as late as the 1930s, there were relatively few specialists in the field of psychology. Numerous theories were proposed about the cause of mental illness and its treatments. Among the less well known were removal of an individual’s teeth and large

intestines, induction of fevers, sleep therapy, hypothermia, and bathing treatments. Individualized treatments surfaced in lieu of group cure-alls. The foundational models of psychoanalysis and behavioral therapy were codified. Interestingly, although the terminology changed, the basic and lasting concept of balance of forces and “a living thing inside a living thing” prevailed. In Psychoanalytic theory, for example, personality was believed to develop from the interactions among the three hypothetical fundamental structures of the human mind: the id, ego, and superego. Conflicts among these three constructs, and our efforts to find balance among what each of them “desires”, determines how we behave and approach the world in either an adaptive or maladaptive manner. What balance we strike in any given situation determines how we will resolve the conflict between two overarching behavioral tendencies: our biological aggressive and pleasure-seeking drives versus our socialized internal control over those drives. Psychoanalytic therapy relies on resolution of the conflicts residing within the defenses of the unconscious mind. In contrast, behaviorism theory posited that mental illness is a construct arising from a compilation of multiple learned behavior patterns. That is, all human behavior is learned, and correspondingly all behavior can be unlearned and new behaviors learned in its place. Therefore, when behaviors become unacceptable, they can be unlearned. Behaviorism bases its notion of mental illness on adaptations and habits and the ever-evolving relationship between the two. Behaviorists describe functioning in terms of the inadequacy of responses, of wrong responses, and of the complete lack of responses to the objects and situations in the daily life of an individual. Through these processes they attempt to trace out the original conditions leading to maladjustment and the causes leading to its continuation.

Much of what we will be talking about in this book will have its roots in this behavioral view of habits, automaticity, and adjustment. (The reader should however be aware of the authors’ prior discussions of the many common threads across therapies.) What will be added is a cogent explanation of how that happens in the human connectome, the neural connections in the organism’s nervous system, the structural seat of processes and integrity of psychological health, and how that knowledge can be used to effect changes leading to more adaptive behavior, including more adaptive cognitions and emotions. Therefore, what is being asked of the reader, and required in order to fully appreciate the current perception of mental health processes, is a paradigm shift; the taking of much of what was taught and thought about as psychology, and reexamining it from the perspective of how the human brain processes information.

Returning to a historical overview, the later part of the twentieth century saw a proliferation of treatments based largely on these two models and the formation of various schools of therapy. These rapid advances in therapy were not necessarily accompanied by advancement in the understanding of the etiology of mental illness or an understanding of how these therapies operate over the connectome. As much as we want to believe that modern science has progressed beyond the treatments described above, or that the present is always the most enlightened time, we cannot avoid the conclusion that our current thinking often continues to reflect the same underlying somatogenic and psychogenic theories of mental illness discussed

throughout this rather brief review of a 9,000-year history. As a case in point, exorcisms are still performed worldwide across religions. The Vatican backed International Association of Exorcists, which was founded in 1990, has licensed some 200 members on six continents.

After World War II, the mental health community in general, and American psychiatry in particular, was discomfited by the chaotic state of organization of classification of mental illness in the United States. At that time, four systems were in use across different sectors of the mental health field. The American Psychiatric Association (APA) came forward in an attempt to address the situation described as a “Tower of Babel”. The result was the DSM (later renamed the DSM-I because it was the first edition in a series of substantive revisions to the original manual). Organizationally, the DSM-I was a hierarchical system in which the initial step in the hierarchy was differentiating organic brain syndromes from “functional” disorders. The functional disorders were further subdivided into psychotic versus neurotic versus character disorders. This organization roughly followed a psychodynamic model. The DSM-I descriptions of disorders were prosaic paragraphs that incorporated behavioral and trait-like criteria; 93 of the 128 categories in this system had prosaic descriptions. These descriptions were very short and added little to what meaning could be derived from the name of the disorder. The terms in the description were relative, and left to the interpretation of the clinician, leading to problems with reliability across professionals.

In 1980, with the advent of the third edition of the DSM (III), the psychodynamic view was abandoned and the medical model became the primary approach. A distinction between normal and abnormal was codified. Most importantly, the DSM became “atheoretical”, describing clusters of symptoms, since it attempted to have no preferred etiology for mental disorders. This was because, at that time, no clear etiological foundation existed. This situation remains in place to date. Two additional iterations of the DSM have failed to change that. Free from having to worry about etiology, therapy (treatments) have been permitted to evolve that do not have empirical foundations for their operation. It has become increasingly obvious that these existing classification systems are antiquated at best and harmful to the advancement of science at worse. There are increasingly strident calls for the replacement of this system which is based upon prevalence of symptoms from clusters of symptoms and their co-occurrence, to the development of a system that would permit the integration of etiology with the development of therapy.

The Research Domain (RDoC) framework is one such attempt. It is centered on dimensional psychological constructs (or concepts) that are relevant to human behavior and mental disorders, as measured using multiple methodologies and as studied within the essential contexts of developmental trajectories and environmental influences. Constructs are in turn grouped into higher level domains of human behavior and functioning that reflect contemporary knowledge about major systems of emotion, cognition, motivation, and social behavior. This model represents a biopsychosocial model of explaining human behavior. In these models,

individuals are born with a genetic predisposition for a certain psychological disorder, but certain psychological stressors need to be present for them to actually present with the disorder. Sociocultural factors such as sociopolitical or economic unrest, poor living conditions, or problematic interpersonal relationships are also viewed as contributing factors. The model developed in this book reflects this thinking. Proponents of the traditional models of mental illness will see elements of their particular truths in the model described above and in the model, we will offer in this book. That is to be desired. Science builds upon itself. The model we will offer has the ability to integrate much of what has come before, or is in use now, within a new framework based on modern connectomics and a small world hub, vertical brain network model of how the brain processes and utilizes information.

The focal point of this introduction is that all of these preceding societies and cultures believed that they were practicing modern and logically derived therapies. While it is true that not all of these practices were derived from a medical foundation, many of them had religious-magical origins, they all were believed to be efficacious by the societies that practiced them. All of them eventually yielded to newer techniques rooted in newer science or newer beliefs and all of these newer techniques were replaced in turn. It would be the height of hubris to assume that the current treatments for mental health represent the pinnacle of human endeavor in this field. The recent development of new or modified treatments, dialectical behavior therapy, acceptance and commitment therapy, neurocognitive learning therapy, clearly demonstrate that the process of ongoing development is continuing and is robust. What we will demonstrate here is that while the development of therapeutic paradigms has continued, the understanding of the disorder they are targeted to treat has not. This is not to say that these therapies do not target depression, obsessive-compulsive disorder or other DSM 5 disorders. They do. What is missing, however, is a clinical understanding of how these treatments are impacted by, and in turn impact human neural networks and physiology to produce the changes therapies claim to produce. How do you really go about changing the way a person thinks and feels? What changes or processes have to impact the human connectome, and in what ways, so that these changes can occur? We simply have not had the benefits of neuroscience to know. And the existing systems have permitted us to avoid these thorny questions for far too long. We can no longer merely state that we practice a particular technique because it works without knowing what about it makes it so. This review section is replete with examples of neologies and strategies considered state of the art for their time. Our currently advanced understanding of neurophysiology, anatomy, and biology makes it time to develop and understand therapy models in relation to the neural architecture they seek to impact. It is to that end that we undertook this work. We intend to offer a cogent model of how the brain is organized to process and profit from information. We will then demonstrate how various existing psychotherapies interact within the model and finally offer a truly integrative approach for the treatment of disorders of mental health. We hope that this work, and the companion works in the series, will

serve as a potential baseline for a future understanding of mental illness and the ongoing efforts to develop effective and empirically valid treatments. It is with intent that some of the existing treatment approaches will be incorporated into this new integrated approach. We also expect that newer approaches will also result from this process. That is the way of science.

Chapter 2

Therapy in the Past and Present



What is psychotherapy? How does it work? Given its prevalence, the answers to these and other likeminded questions would appear to be readily available. Psychotherapy is one method utilized to address issues with mental illness, and mental illnesses are quite common in the United States. Recent data suggest that one in six U.S. adults lives with a mental illness (44.7 million in 2016) (National Institute of Mental Health, 2018). Psychotherapy is therefore fairly ubiquitous. Estimates vary a bit, but in general it is estimated that about 27% of the population of the United States has received services for mental illness, and 30 million of those are receiving, or has received, psychotherapy. However, psychotherapy has never achieved the full recognition of a “hard science.”

Given the amount of psychotherapy that is occurring, you would not be blamed for thinking that there was consensus as to what constituted psychotherapy. You just might be incorrect, however, as vague definitions abound. For example, “Psychotherapy, or talk therapy, is a way to help people with a broad variety of mental illnesses and emotional difficulties. Psychotherapy can help eliminate or control troubling symptoms so a person can function better and can increase well-being and healing” (American Psychiatric Association, 2018a) or this “Psychotherapy involves communication between patients and therapists that is intended to help people:

- Find relief from emotional distress, as in becoming less anxious, fearful or depressed.
- Seek solutions to problems in their lives, such as dealing with disappointment, grief, family issues, and job or career dissatisfaction.
- Modify ways of thinking and acting that are preventing them from working productively and enjoying personal relationships.

Psychotherapy begins with some discussion of a person’s background and the concerns that led him or her to seek help. Following this initial assessment, the patient and therapist come to an agreement, called the treatment contract. The treatment contract specifies the goals of treatment, treatment procedures, and a

regular schedule for the time, place and duration of their treatment sessions. Sometimes this treatment contract is written down explicitly, but more often it is discussed between patient and therapist (American Psychological Association, 2018b).” These definitions are both broad and vague, and do not really help us understand how this particular treatment, psychotherapy, impacts how we adapt to difficult and frustrating situations. The description of talk therapy leaves much to be desired, scientifically speaking. In fact, the descriptions are devoid of explaining a scientific base for the efficacy of psychotherapy. While “sharing” or “venting” may be palliative or therapeutic, it is not therapy. Understanding the impact of psychotherapy has long been outside the realm of neuroscience. Recent advances are changing that, bringing an understanding of how psychotherapy affects the human nervous system, and subsequently emotional and behavioral health, from a scientific standpoint.

The Mind Body Problem and Therapy

As we have suggested elsewhere, many of the problems regarding the lack of neurological, neuropsychological, and neurophysiological understanding concerning the nature of psychotherapy can be traced to the historical mind–body problem (Wasserman & Waserman, 2016). The mind–body problem (Radner, 1971) concerns itself with how the mental health professional and scientist understands the relationship between the mind and the body. According to this model, the mind is about mental processes such as thought and consciousness. The body is about the physical aspects of the neural architecture and how the brain is structured. The mind–body problem reflected the understanding of how these two interact. Historically, they were considered different and separate constructs that either operated somewhat independently, at least or interdependently at most. While it is clear that the two are closely related, mental processes were conceptualized as distinct from physical processes and independent of the physiology of the organ (the brain) where they nevertheless resided. The mind was where emotions resided, and when these emotions became disrupted somehow, most mental health problems resulted. Some philosophers remarkably held that mental properties involving conscious experience had fundamental properties that were not governed by the laws of physics. This separation has in fact persisted into very recent times in most fields of mental health remediation. It has allowed mental health professionals to develop treatment strategies that ignored the neurophysiology of learning and the neurology that underpins it.

“As a discipline, psychology is defined by its location in the ambiguous space between mind and body, but theories underpinning the application of psychology in psychotherapy are largely silent on this fundamental metaphysical issue” (Leitan & Murray, 2014). As a result of this situation, according to Leitan and Murray, the theoretical foundation of psychopathology (the study of the nature and treatment of mental disorders) can be described as similar to that of biology’s before Darwin,