THE MAKING AND BREAKING OF MINDS

How social interactions shape the human mind

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For
Kaylee and John

Table of Contents

	List of Figures	vii
	Acknowledgments	ix
	Introduction	xi
Chapter 1	**Shedding New Light on the Nature-versus-Nurture Debate**	1
Chapter 2	**Brain Development and Plasticity**	23
Chapter 3	**Normalcy in the Light of Plasticity**	49
Chapter 4	**Gene Expression: Nurture Fueling Nature**	85
Chapter 5	**Neurobiological Processes of Memory Formation**	107
Chapter 6	**The Effects of Emotion, Stress, and Traumatic Experiences on Cognition**	141
Chapter 7	**The Social Brain: Attachment & the Effects of Emotional and Social Neglect on Cognition**	165
Chapter 8	**The Devastating Impact of Violence**	201
Chapter 9	**Resilience & Nurture Put into Practice**	227
	Bibliography	243
	Index	273

List of Figures

Figure 1.1: N. Hartsoeker's homunculus derived from a sperm cell. Lawrence, Cera R., "Hartsoeker's Homunculus Sketch from Essai de Dioptrique," *Embryo Project Encyclopedia (2008-08-14)*. 2

Figure 1.2: Ontario Premier Mitchell Hepburn with the Dionne babies in 1934. From the Library and Archives Canada, "Mitchell Hepburn with Dionne Quintuplets," reproduction reference number C-019533. 5

Figure 1.3: Dionne quintuplets (at the age of 13) in 1947 with their parents and a priest in the background. From the Library and Archives Canada, reproduction reference number PA-155518. 6

Figure 1.4: The iconoclastic symbol of today, the DNA double helix Public Domain Picture, Ref. 17902 from Pixabay. 7

Figure 1.5: "Painting hands" photo-manipulation inspired by the artwork of M.C. Escher "Drawing hands" (@AdobeStock_215491054). 20

Figure 2.1: A phrenology chart of 1883 Credit: Phrenology: Chart. Credit: Wellcome Collection. Attribution 4.0 International (CC BY 4.0). Chart from 'The Phrenological Journal' ("Know Thyself"), print from Dr. E. Clark. 27

Figure 2.2: Brain of Mr. Leborgne alias Tan. From Dronkers et al., 2007, p. 1436. Original at Musée Dupuytren, Paris. 30

Figure 2.3: Sensomotoric cortex, after Penfield and Rasmussen (1950). Image modified. 33

Figure 3.1: Fritz Kahn (1926) Der Mensch als Industriepalast. In: Das Leben des Menschen, Band 3. Stuttgart: Kosmos Gesellschaft der Naturfreunde, Franckh'sche Verlagshandlung. 51

Figure 4.1: The cloning procedure of Dolly. Source: Pawar, "Transgenic Animals: A Short Review." Image modified. 94

Figure 5.1: Schematic picture of a neuron; the DNA is located in the nucleus of the neuron (modified from @AdobeStock_290162954). 120

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Introduction

Close to the historical city center of Vienna, there is an imposing building, opened first in 1862 by the Austrian pathologist, politician, and philosopher Carl von Rokitansky. The time-honored walls have served as the pathological-anatomical institution for more than a century. Visitors, students, and staff who enter the historic halls are welcomed by an epigraph at the pediment that still bears witness to its original dedication and reads *Indagandis sedibus et causis morborum*, which best translates to "Investigating the seat and causes of diseases." Today, the premises host the Center for Brain Research, a renowned research institution that is devoted to the investigation of brain functions in health and disease. Usually, the facilities of the center are not open to the public, but for one week every year, hundreds of teenagers between the ages of fifteen and eighteen flock into the venerable halls that are steeped in history. Once a year in March, the institute opens its doors for Brain Awareness Week, a global campaign to foster public enthusiasm and support for brain science.

In March 2014, about eighty teenagers, teachers, and a few other visitors crammed into the lecture hall of the Center for Brain Research. I gave a talk on the "Social Brain," discussing how social interactions shape the human mind. I was particularly interested in this topic, as I had previously changed my focus of research from molecular neuroscience to cognitive science and moved from the wet lab and microscopic studies of brain cells to a more theoretical approach, giving me a bird's eye view on the brain. My inspiring collaborations with philosopher and evolutionary biologist Werner Callebaut and anthropologist Daniel O. Larson particularly challenged a lot of assumptions and conceptual reasoning I had been trained in for almost two decades. Assumptions such as: it's the genetic makeup that determines our cognitive development. Or: all psychopathologies are a consequence of either a biological disease or a severe head injury. And last but not least: human cognition is the sole product of biological evolution, it's survival of the fittest, stupid!

The atmosphere in the lecture hall was exuberant, most likely due to the students' excitement of being out of their usual school setting and getting a whiff of the scientific world of brain research. The plenary discussion that followed the talk was vivid, and I tried my best to answer varied questions about brain processes, questions that usually derived from students' and teachers' own experiences and introspection. At the end of the event, I spotted my brother Peter, who was also in the audience. He approached me, coming to the front desk. Peter is a social education worker and was also teaching at the College of Social Vienna at that time.

Standing amidst a group of young students, he said, "I wish that many more people would learn about how our social environment shapes cognitive development. It would open our eyes to the importance of nurturing relationships, especially for children and teenagers."

"Social relationships are your domain," I responded with a smile, not fully understanding what he was trying to suggest. Scientists are usually more interested in elucidating theoretical causes of phenomena observed under very strict control of study parameters in experimental settings. When it comes to situations in daily life, scientists often have little to say—or prefer not to say much—about how research findings translate into real-life scenarios. Peter insisted that there was a lack of discourse between brain research and pedagogy, in particular social pedagogy. And this lack was to the detriment of all parties concerned.

He had a point. I remembered a conference I attended two years earlier that was organized by the Institute for Advanced Study in Delmenhorst, Germany. The conference was aimed at an interdisciplinary exchange between teachers and educators of biology and educational scientists. During one of the event dinners, I had the pleasure of sitting next to the keynote speaker of the conference, a professor of psychology and an expert in teaching-learning research. Throughout dinner, she repeatedly expressed her conviction that contemporary neuroscience could hardly contribute anything meaningful to psychology or help understanding how to educate children. By the end of the dinner, there was no feather left in the cap of a putative interdisciplinary endeavor between neuroscience and education. Her disdain for neuroscience was not directed at me or any of the other brain researchers present, in fact, one of her close collaboration partners was a neuropsychologist who specialized in neuroimaging of children during learning tasks. Her dismissal of the field was largely due to the fact that neuroscience, how she saw it, was a laboratory science that had nothing to contribute to real-life situations. While brain scientists sat in their professional ivory tower, educators and child psychologists were out there in the "wild" trying their best to fit day-to-day observations into traditional psychological theories. If anything, neuroscience may become relevant in a distant future when its methodology becomes applicable to genuine issues of everyday life. Until then, teachers, child care workers, and other experts working with children and teenagers had to rely on their real life, professional training, intuition, and historical, pedagogical knowledge. That's at least how my neighbor at the table saw it.

Remembering this incident at the conference dinner in Germany, I knew Peter's argument was right. Neuroscientists do not interact much with educators. There are of course some occasions of interdisciplinary exchange of individual researchers, but very often the fields remain separate, exposing a

scarily vast explanatory gap that none of the disciplines is willing to tackle. And there are good reasons for hesitation. The human brain is complex; trying to understand it requires the joint effort of many subdisciplines, and we are still decades, if not centuries, away from having a solid picture of how any brain, let alone the human brain, works. In 2013, the European Union funded the Human Brain Project that employed scientists from more than a hundred partner institutions. A staggering one billion Euros were pumped into this flagship project with the aim of elucidating the mechanisms that underlie cognition, learning, and memory formation. Despite impressive advancements produced in the course of this huge, international endeavor, a comprehensive explanation of how the brain gives rise to the aforementioned cognitive processes still seems as far as ever.

I tried to dodge Peter's complaint. Researchers see it as a virtue to keep a low profile rather than offering speculations that are not fully substantiated by empirical data. I, like so many other scientists, had subscribed to this conviction for a long time. Much more research on cognition is required before we can connect the interdisciplinary threads of all data available. I was convinced that with this cautious stance, I voiced the opinion of the scientific community, not just my humble opinion. It's bold, if not irresponsible to make scientific claims without having all evidence necessary for a conclusion.

"Do you think it is more responsible to wait until scientists have gained a more complete understanding of the workings of the human brain while some people still accept it as a fact that their childhood experiences have little to do with their cognitive development frequently ensuing struggles later in life?" Peter challenged my reluctance.

That evening, I went home pondering how basic research often seems detached from what is going on around us. That is actually considered to be a good thing. As a researcher, you want to be objective—unaffected by anecdotal evidence or spurious cases. The more you accept a certain theory or follow a certain concept, the less open you are to critique, disproof, and counterfactuals. In a nutshell, as a researcher, you need to stay detached. Or not? The more I discussed and exchanged with philosophers of science, the more I became aware of how untenable the belief of objectivity in science really is. While many scientists may still argue that scientific claims are objectively describing facts about the world, it has been shown for a plethora of situations, including scientific work, that individuals' experiences vary greatly with personal situations, idiosyncrasies, the methodology and instruments available, as well as language, gender, and culture. In fact, psychologists have long emphasized an important distinction between sensation and perception to account for how aspects and phenomena from "out there" in the world are processed within our brains—be it the brain of a scientist or any other person. Thus, true objectivity in

science is a naïve idea. Thomas Kuhn's and others' analyses have convincingly shown that scientists always view research problems through the lens of a paradigm that is bounded by axioms, methodological presuppositions, state-of-the-art techniques and concepts, and so forth. History and philosophy of science can open our eyes to how science has been and still is riveted by its academic zeitgeist and carve out conceptual shortcomings as inevitable consequences of our bounded rationality as humans. Perhaps it was time to look at brain development and cognition through the lens of social pedagogy? Maybe it was time to set the focus on cognitive development in children growing up in impoverished environments and under socio-economic hardship?

Fast forward a few years. The idea that social interactions have an immense impact on infant brain development has gained momentum in brain research. More and more scientists have started to look into how nature and nurture are intertwined. Researchers have designed ingenious studies—sometimes lasting over many years—that elucidate how stress, trauma, and deprivation influence the human brain. Such empirical observations and experiments pertain to an individual's development as well as transgenerational phenomena. The importance of social interactions for cognitive development—especially during infancy, childhood, and puberty—has become an undeniable factor in the scientific quest of understanding cognition. Yet how much of these findings have reached a destination where experts from neighboring disciplines or other fields can use these novel insights? There is still much to be done to bridge the interdisciplinary gaps and foster collaboration.

After the discussion I had with my brother in 2014, I have more and more closely worked with experts from various fields, including social workers, developmental psychologists, and child psychoanalysts. Many of the insights provided in the book are based on long discussions that familiarized me with puzzling discoveries or observations from fields of expertise separate from my own. Frequently, I was challenged to rethink previous, and often too simple, technical suppositions that followed ceteris paribus assumptions (i.e., all other things being equal or held constant). Sometimes, my conclusions were turned topsy-turvy, especially when I met children, teenagers, and adults whose personal history challenged findings from laboratory settings. In all cases, the people I had the pleasure and honor to work with were a constant inspiration to me and my work.

Some of the most important issues on the influence of social environment on human cognition that came out of these interdisciplinary interactions with a multitude of people shall be discussed in this book, a book that is the culmination of work and insights from numerous individuals—I just have the privilege of putting them into writing.

Chapter 1

Shedding New Light on the Nature-versus-Nurture Debate

> *When the male semen is enclosed in a hermetically sealed vessel for forty days and "putrified" in venter equinum, a moderately warm water bath that is supplied by the fermentation heat of horse dung, a human-like being will be generated from itself, but one that is transparent and without a body. By nurturing this being with the "arcanum sanguinis humani" – human blood – for 40 weeks, a quite vivid human child is created similar to one born by a woman, but much smaller. The former we call homunculus.*
>
> — Paracelsus. De generatione rerum naturalum (In: De Natura Rerum)

This excerpt of a recipe of how to generate a human-like creature—a so-called homunculus—without the need of a female womb can be found in Paracelsus' book *De Natura Rerum* that was published in 1584 and exerted its influence over centuries. Paracelsus, the medieval scholar, healer, and alchemist, provides herein a practical guide for the creation of life by mixing organic ingredients like semen and blood.[1] Nonsense. Superstition. Nobody would believe such unscientific babble anymore... yes, of course. But historically entrenched ideas resist abrupt disposal and often remain in our cultural knowledge for a long time. They might even change their appearance and get disguised in new, more reputable theories. The idea of human creation is such an example of how old, mythic notions strongly contributed to the intellectual framework of later scientific concepts. Paracelsus' homunculus constituted the foundation of how natural scientists of the seventeenth century thought about human procreation.

In 1677, Johan Ham discovered tiny particles in male semen and established the basis for the so-called preformation theory that prevailed until modern times. The Dutch astronomer and naturalist Nicolas Hartsoeker speculated in his work, published in 1694, that these tiny particles observed by Ham each

[1] Paracelsus, *De Natura Rerum.*

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Index

A

Acetylcholine, 152
Adaptation, 17, 40, 43, 58, 60, 66, 67, 73, 77, 78, 79, 103, 173, 183, 189, 190, 224
Adrenocorticotropic hormone (ACTH), 153, 154, 211, 212, 216, 222
Allele(s) (variations of a given gene), 15, 18, 102, 214
Alloparenting, 229, 230, 237
Amygdala, 109, 126, 136, 137, 139, 140, 147, 148, 149, 150, 151, 152, 153, 154, 156, 158, 159, 160, 161, 162, 163, 172, 181, 182, 183, 184, 185, 189, 191, 196, 213, 214, 215, 218, 219, 220, 221, 229, 230
Anderson Carol M., 239, 240
Antisocial behavior, 34, 57, 90, 212, 213, 223
Anxiety disorder, 137, 181, 188, 218, 222
Apoptosis, 81, 153
Arousal (emotional), 80, 142, 150, 151, 152, 155, 162, 174
Associative learning, 124, 125, 144, 145, 146, 148, 165
Attachment style, 181, 182, 223, 224
Attachment theory, 179, 180, 183, 188, 203
Attention, 142, 160, 188, 196
Attention deficit hyperactivity disorder (ADHD), 57, 74, 75, 83
Autoimmune disease, 23, 135
Autobiographic memory, 112, 113, 139
Automaton, 49
Autonomic nervous system, 88, 147, 148, 153
Axon, 42, 45, 81, 120, 121, 180

B

Bakwin Harry, 168, 169, 177
Behaviorism, 143, 144, 145, 165, 234
Binet Alfred, 11
Blakemore Sarah-Jayne, 47, 191, 192
Blueprint (genetic; molecular), 7, 14, 40, 66
Brainstem, 148, 152, 153, 184
Broca Paul, 29, 30
Broca's area, 24, 39
Boorse Christopher, 61
Bowlby John, 177, 178, 179, 180, 188

C

Capgras syndrome, 139
Cartwright Samuel A., 52, 53
Causal-mechanistic (explanations), 50, 73, 75
Caspi Avshalom, 213, 214, 215
Cerebellum, 45, 184, 185
Cerebral cortex, 23, 24, 38, 113, 117
Childhood amnesia (infantile amnesia), 128, 132, 133, 134
Circle of courage, 232, 233, 234, 235, 236, 237, 238
Concept cells, 115, 116, 117, 118, 119

Conditioning, 143, 144, 145, 146, 147, 148, 149, 151, 165, 182, 220, 221, 222, 234
Corpus callosum, 129, 130, 188
Corticotropin-releasing hormone / factor (CRH / CRF), 154, 156, 172, 173, 183, 212, 216, 222, 229
Cortisol, 155, 157, 158, 174, 184, 196, 211, 212, 213, 214, 215, 216, 217, 218, 222, 223, 230, 231, 233
Cortical-limbic circuit, 136, 137
Cultural evolution, 20, 67, 68, 73, 234, 237

D

Damasio Antonio R., 159
Darwin Charles, 3, 19, 77
Darwinian fitness, 203, 204, 205, 209
Declarative memory, 112, 113, 116, 126, 132, 135
Deep brain stimulation, 38
Dendate gyrus, 133, 134, 187
Dendrite, 120, 121, 153
Descartes René, 7, 8, 49, 159
Determinism (gene / genetic), 6, 7, 12, 88
Diagnostic and Statistical Manual of Mental Disorders (DSM), 52, 74
Dionne quintuplets, 4, 5, 6, 8, 9, 10, 21, 96, 97
Distress, 101, 154, 188, 189, 217, 231
DNA (deoxyribonucleic acid), 3, 4, 7, 85, 86, 87, 91, 93, 94, 95, 96, 97, 100, 101, 102, 119, 120, 185, 213
Dopamine, 17, 88, 125, 145, 146, 147, 152
Double helix, 7
Drapetomania, 52, 53, 54, 55, 61, 65, 73, 74
Dromomania, 54, 55, 57, 58, 60, 65, 73, 74
Dully Howard, 35, 36
Dunbar Robin, 186
Dunedin Multidisciplinary Health and Development Study, 213, 214

E

Edelman Gerald, 41
EEG (Electroencephalogram), 108, 124, 125
Electrophysiology, 115, 124
ENCODE (Encyclopedia of DNA Elements), 92
Epigenetics, 3, 91, 95, 101
Epilepsy, 9, 29, 31, 32, 108, 125, 129
Epinephrine (=adrenaline), 153, 163, 184
Episodic memory, 112, 113, 117, 118, 126, 127, 128, 134, 136, 138, 139, 142, 143, 151, 162, 218
Equipotentiality, 111, 112, 114, 123
Eustress, 154, 217
Evolutionary mismatch, 72, 73, 187
Evolutionary psychology, 40
Evolutionary theory, 3, 208
Exaptation, 67
Explicit memory, 132, 135, 143, 151, 152, 153, 154, 155, 163
Extrauterine fetus, 45

F

Ferrier David, 31, 32
Fight-or-flight response, 162, 231

Filicide, 205, 206, 207, 208, 209, 210, 211, 212
Flashbulb memories, 152
Flynn (effect), 13
Flynn James R., 13
Frankl Viktor, 238, 239
Freeman Walter, 34, 35, 36, 37, 108
Freezing (behavior), 148, 150, 156, 182, 215
Fritsch Gustav, 31, 32
Fugue, 54, 55, 58
Fulton John F., 33, 34

G

Gall Franz Josef, 26
(GABA) Gamma-aminobutyric acid, 172, 183
Gazzaniga Michael, 129, 130, 132
Gene-centric view, 40, 210, 215
Gene expression, 11, 21, 44, 85, 91, 93, 95, 101, 119, 120, 121, 122, 123, 124, 131, 148, 172, 173, 175, 183, 196, 229
Gene-environment interactions, 18, 21, 40, 44, 215
Genetic program, 6, 18, 19
Genome, 4, 18, 75, 86, 92, 93, 95, 96, 97, 101
Glia cells, 120
Glucocorticoid, 153, 154, 156, 157, 158, 172, 173, 217, 218
Goddard Henry H., 12, 13
Gould Stephen Jay, 45, 66, 67
Grandmother cell, 115
Grandmother hypothesis, 237
Growth cone, 42

H

Hacking Ian, 57, 58
Hardwired, 42, 44, 25
Hartsoeker Nicolas, 1, 2, 7
Harlow Harry, 170, 171, 174, 179, 180, 184
Harvey William, 49
Hebb Donald, 34, 123, 124
Hebbian learning, 124, 138
Hemispherectomy, 23, 24, 25
Hippocampus, 116, 117, 118, 119, 122, 125, 126, 127, 133, 136, 137, 140, 145, 151, 152, 153, 154, 155, 156, 184, 191, 196, 215, 217, 218, 221
Hitzig Eduard, 31, 32
Homeostasis, 66, 77, 78, 89, 90, 154, 212
Homburger August, 55, 56, 57
Homosexuality, 52, 65, 73, 167
Homunculus, 1, 7
Hrdy Sarah Blaffer, 209
Human Genome Project, 92
Huttenlocher Peter R., 46
Hypermnesia, 163
Hypervigilance, 162, 181
Hypothalamic-pituitary-adrenal axis (HPA axis / stress axis), 174, 184, 212, 213, 216, 217
Hypothalamus, 136, 148, 152, 154, 183, 184, 215, 230
Hysteria, 55, 57

I

Implicit memory, 132, 134, 135, 143, 147, 148, 151
Infantile amnesia (=childhood amnesia), 128, 135
Infanticide, 204, 205, 206, 207, 208, 209, 210, 211
IQ (intelligence quotient), 12, 13, 87, 88, 150
IQ test, 11, 150

J

Jackson John Hughlings, 31
Jacobs Harriet Ann, 53
Jacobson Carlyle, 34
James William, 44, 114, 142
Joint attention, 188

K

Kahn Fritz, 49, 50, 51
Kangaroo-mother-care, 10
King Robert Hillary, 193, 194, 195, 196, 198
Kraepelin Emil, 54, 55

L

Lamarckism, 3
Lange Carl, 142
Lashley Karl Spencer, 110, 111, 114
LeDoux John, 147, 148
Lewontin Richard, 7, 14, 66, 79
Lieberman Daniel, 72, 73
Limbic system, 139, 140, 161, 214, 137, 139
Little Albert, 144, 145, 165
Lobotomy (transorbital), 35, 36, 37, 38
Localizationism, 29, 31, 32, 39, 40, 109, 115
Locus coeruleus, 153, 163, 184, 220, 229
Long-term memories, 111, 117, 121, 123, 125, 126, 127, 133, 134, 136, 148
Looping effects, 57, 59

M

Maladaptation, 17, 80, 183
Massive modularity hypothesis, 40
Maslow Abraham, 231, 232,
Mason Mary Ann, 70
Meaney Michael J., 171, 172, 175, 183, 184
Mechanistic (thinking / view / explanations), 49, 50, 61, 73, 75, 90
MTL (Medial temporal lobe), 116, 117, 119, 126, 127
Medical model (of disease), 50, 52, 61, 73, 74, 75, 76, 89
Mendel Gregor, 3, 4
Milner Brenda, 111, 112, 113, 143
Modern Synthesis, 3
Modularity, 40, 41
Moffitt Terry, 213, 214, 215
Molaison Henry, 107, 109, 111, 112, 114, 115, 117, 124, 125, 127, 138, 141, 143
Moniz Antonio Egas, 34
MAO-A (Monoamine oxidase-A), 86, 87, 88, 89, 90, 213, 214
Myelin sheaths, 120
Myelination, 45, 81, 153, 180
Myopia (shortsightedness), 15, 16, 17, 18, 19, 20

N

Natural selection, 3, 13, 15, 19, 21, 66, 67, 68, 205, 210
Naturalistic (account / view), 74, 75, 83
Nature–nurture, 7, 8, 19, 21, 59, 61, 68, 90, 97, 240
Neurasthenia, 55
Neurodiversity, 75, 76, 83
Neurogenesis, 45, 133, 134, 153, 155, 180, 185
Neuromodulators, 125, 152, 153
Neuronal assemblies, 123, 124, 125, 141
Neuron doctrine, 121

Neuroplasticity, 21, 24, 40, 41, 42, 44, 46, 59, 67, 81, 83, 91, 121, 122, 133, 140, 160, 173, 180, 184, 196, 220
Neurotransmitter, 74, 86, 88, 89, 90, 122, 145, 146, 152, 153, 156, 158, 162, 173, 183, 184
Neurostimulator, 38
Niche construction, 19, 21, 65, 67, 68, 69, 70, 72, 73, 76, 79, 180, 210, 224
Niche picking, 79, 80, 103
Norepinephrine (=noradrenaline), 88, 152, 153, 158, 163, 184, 220, 229
Normalcy, 53, 61, 65, 73, 76, 77, 78, 83, 89
Normativist (account), 73, 74
Nucleus accumbens, 38, 136

O

Ontogeny, 42, 140, 219
Orbitofrontal cortex, 146, 160, 162,
Oxytocin, 171, 172, 185, 186, 230, 231, 233

P

Pangenesis theory, 3
Paracelsus, 1, 4
Parasympathetic nervous system, 153, 231
Parent-offspring conflict, 81, 82, 205, 206
Parkinson's disease, 38
Pathologizing language, 240
Pavlov Ivan Petrovich, 143, 144
Penfield Wilder, 32, 33, 38, 39, 40, 109, 111, 113
Phrenology, 26, 27, 28, 29, 40, 110
Place cells, 118, 119, 122, 123, 145
Poisonous pedagogy, 165
Polymorphism, 185, 186, 214
PTSD (Post-traumatic stress disorder), 135, 136, 137, 157, 161, 162, 215, 221
Preformationism, 7
PFC (Prefrontal cortex), 34, 35, 125, 126, 127, 136, 151, 158, 160, 191, 215, 221, 222, 223
Procedural memory, 112, 155
Pruning (synaptic), 41, 46, 82, 133
Psychoeducation, 239, 240
Psychometrics, 11
Psychopathologies, 15, 21, 50, 52, 54, 55, 57, 58, 60, 61, 62, 73, 79, 83, 89, 90, 102, 135, 171, 178, 187, 202, 206, 207, 208, 215, 221
Psychosurgery, 33, 34, 38

R

Ramachandran Vilayanur S., 139
Ramon y Cajal Santiago, 23, 42, 43, 111, 121, 122
Rasmussen's encephalitis, 23
Reference group, 52, 53, 61, 65, 75
Reminiscence bump, 47, 140
Resilience, 172, 173, 197, 198, 215, 228, 229, 231, 232, 236, 238, 239, 240
Resnick Philipp, 207, 208
Reticular theory, 121
RNA (ribonucleic acid), 18, 91

S

Sapolsky Robert, 156, 157, 189
Scoville William Beecher, 107, 108, 109, 111, 112
Secondary traumatization, 163
Self-awareness, 222

Semantic memory, 112, 127, 142, 143
Serotonin, 74, 86, 88, 89, 90, 152, 158, 159, 176, 177, 214, 223
Shame-guilt-anxiety cycle, 238
Short-term memory, 113, 133
Social buffering, 219
Social niche, 58, 68, 69, 70, 71, 72, 79, 80, 83, 100, 104, 112, 166, 183, 203, 211, 224, 225
Somatosensory cortex, 24, 148
Somatotopic organization, 33, 109
Sperry Roger, 129, 130
Spitz René, 169, 170, 177
Split-brain, 129, 130, 132
Statistical normality, 61
Stedman Thomas Lathrop, 54
Stranger distress, 230
Stress axis (Hypothalamic-pituitary-adrenal axis), 154, 156, 158, 159, 162, 184, 211, 212, 216, 229
Sullivan Regina, 218, 219
Suomi Stephen, 174, 175
Sympathetic nervous system, 88, 152, 153, 174, 215, 222, 223, 231
Synaptic plasticity, 82, 121, 122, 124, 148, 152, 220
Synaptogenesis (emergence of new synapses), 41, 81, 82, 133
Systems theory, 60

T

Toxic stress, 140, 215, 216, 217, 218, 228
Trauma, xiv, 46, 58, 97, 102, 135, 136, 153, 154, 155, 157, 158, 159, 161, 162, 163, 186, 215, 216, 217, 235, 240
Trivers Robert, 81, 205
Twin studies, 8, 96

U

Urbach-Wiethe disease, 149, 150

V

Vagal nerve, 153
Van der Kolk Bessel, 135, 136
Variation (genetic), 9, 13, 14, 18, 75, 91, 95, 214, 230
Vasopressin, 154
Ventral tegmental area, 136
Voisin Félix, 28
Vrba Elizabeth, 67

W

Waldroup Davis Bradley Jr., 85, 86, 88, 89, 90, 102, 213
Wandertrieb, 55
Watson John B., 144, 145, 165, 166, 167, 168
Werner Emmy, 228
Wernicke's area, 24
Wilhelminenberg (castle), 62, 63, 65
Winfrey Oprah, 227